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A TREATISE Concerning the HEAT OF THE BLOOD: And also of the USE OF THE LUNGS.

By *RICHARD BOULTON*, of *Brazen-Nose College* in *OXFORD*.

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20

IMPRIMATUR.

Jo. MEARE

Vice-Can. Oxon.

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1697.

HUNC Librum (cui Titulus, *A Treatise of the Heat of the Blood*, &c.) dignum Censemus; quî Imprimatur.

Thomas Millington, PRÆSES.

Samuel Collins,
Edward Hulse,
Richard Morton,
Charles Goodall,
} CENSORS.

Martij 5.
1697.

MVSEVM
BRITAN
NICVM

TO THE

Reverend

Dr. *JO. MEARE*

PRINCIPAL

OF

Brazen-Nose College,

AND

VICE-CHANCELLOR

OF THE

Universſity of *Oxford*.

SIR,

IT is not any great Opinion I have of my preſent Performance, A 3 (though

(though there are ſome who would perſwade me, that it is not altogether deſpicable) that makes me preſume to prefix your *Name* before it.

Indeed, amongſt Men of Senſe and Learning, *Truth* for the moſt Part brings it's

it's own Recommendation along with it, and finds that Candid and ready Reception which it deſerves. But the Generality of Mankind will not reliſh any thing, that bears not in the Front ſome great and eminent Name.

And for this Reason it is, that I have made bold to make this *Dedication.*

Your real Worth which hath deservedly placed you in two Eminent Stations, to both which you do more Honour than you receive from them: And the Encouragement and

and Favour you ſhew to all Perſons of Induſtry, Vertue and good Learning under your Government, ſoon determined me in the Choice of ſuch a Patron; though my ſmall Share of each of the latter, could merit neither of the former.

And here, according to the usual Mode of Dedications, I might easily enlarge upon so fair a Character; But as it is your peculiar Delight to oblige & do good with all the ease and sweetness imaginable, so with as little Noise and Ostentation possible:

And

And I ſhould ſooner hope for your Pardon for this Preſumption and the Faults of my Book, than for ſuch an Attempt upon your Modeſty.

I ſhall therefore only add, that you would be pleaſed to accept this as a Teſtimo-

mony of my Duty and Gratitude, and that I shall always remain,

Reverend SIR,

Your

Ever Obedient

and Obliged

Servant

R. BOULTON.

To the very

LEARNED

AND

JUDICIOUS

Dr. *R. ANGELL*,

Reſident in the

CITY of *CHESTER*.

Learned Sir,

SIXTEEN *Years Education in a Univerſity, and a great many more improved in ſucceſful and judicious Practice, hath ſufficiently*

ly qualified You for a Judge and Patron, when I consider the former and withal my own Weakness, I confess I have less Reason to desire the latter: But since it usually happens that those that are least subject to Faults are commonly candid Criticks, and most ready to forgive others: I am bolder to beg your Patronage; yet not for it's Faults, since that is below your Judgment, but whatever Truth is contained in it, which will scarce be deny'd by One that is so much an Encourager of Learning.

But perhaps I ought to make an Apology to You as well as the World, for deviating from the

Opinions

Opinions of ſome Learned Men; eſpecially of that never too much Honoured Dr. Willis, *who was One of the Greateſt Phyſitians of his and preceding Ages. And truly all that I can ſay for my ſelf, is, That as it would be below the Character of ſo Great a Man, to write any Thing upon any other Conſideration, than an* Improvement *of* Knowledg *and* Truth; *ſo, undoubtedly, he would not deſire any Thing he writ ſhould be believed except it ſeemed ſo.*

That then which I hope, will be an Apology for ſuch an Attempt, is, That I have conſidered his Opinion, with no other Deſign

ſign than an Endeavour after Truth, and have offered nothing againſt his Opinion, but plain and unprejudiced Reaſons; and though I have given Reaſon enough to prove he was miſtaken in this Point, yet I muſt ever have the greateſt Veneration and Eſteem for all ſuch Men of unparalleled Worth and Learning, and ſo candidly Ingenuous.

But whether this little BOOK may pretend to any Reaſon for what it offers or not, I am more encouraged to ask Your Patronage, it being approved by Men of noted Learning and eminently Judicious, the Preſident *and* Cenſors *of the* College *of* Phyſitians

ans, *of which Number that your Self is not a Member, no other Reaſon can be given, but that Your own Choice of a more retired Life hath fixed you in that* CITY, *where you are now reſident, to the Satisfaction and Good of thoſe that commit themſelves to your Care.*

But, Learned Sir, That I may not preſs too much upon your Patience, That Patronage which you were pleaſed to Give my Laſt, when I was a Stranger to You, both encourages me to hope for it, now You have been pleaſed to take me into Your Favour; and alſo, that You'll Pardon me for taking this Liberty, ſince it

is only designed to testify my Gratitude for those Favours You have already been pleased to Confer on

Your

very Humble

and Obliged

Servant

R. BOULTON.

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OF

OF THE HEAT OF THE BLOOD.

EVEN Philoſophy in General is ſo Myſterious, and ſo infinitely out of the reach of our ſhort and weak Capacities; that the beſt of Philoſophers may truly be ſaid

Our Knowledg in Philoſophy is limited to a ſmall Part of the Creation.

to have, but a ſlight and ſuperficial Knowledg of it: For if that ſmall Part we know, be compared with what we know not; all our Knowledg is but as an inviſible Speck; thoſe things to which it extends, being inconſiderable, if compared with that vaſt and endleſs Maſs of the Univerſe.

Which is furniſhed with Objects too copious for our Senſes

But although that Part of the Univerſe, which in ſome Meaſure lyes within the Cope of our Senſes, be ſmall and inconſiderable, when compared with the vaſt Extent of the whole Creation; yet when we reflect on the vaſt Variety of Objects, contained within thoſe narrow Dimenſions; we find,

find, and must needs acknowledg it very considerable; and superabundantly furnish'd with Matter for our Senses to work upon.

Of which at the best we have but an imperfect Knowledg.

For, the Extension of our Knowledg, as to those Objects, is bounded by Limits not very spatious; & notwithstanding the Diligence and Industry of Learned Men, and the great Improvements, made in most Parts of Knowledg: The wisest Men, and the most profound Philosophers must of necessity own, that of those Things they know most, their Knowledg is very imperfect. *We know but in Part*, and indeed so small a Part, that it chiefly seems to

inform us, more ſenſibly of our Ignorance.

The Purſuit of Knowledg very deſirable.

But ſo pleaſant and deſirable is Knowledg; and we find ſo much uneaſineſs in Ignorance, when once we have taſted of it; that it's impoſſible to abſtain from a further Purſuit after it at leaſt, notwithſtanding the vaſt diſproportion betwixt our Knowledg and Ignorance, which continually lyes in our way to diſcourage us.

Eſpecially of that which is moſt Advantagious.

And as we thirſt after Knowledg, with a deſire to attain to a more adequate and compleat Apprehenſion of it; ſo we moſt eagerly purſue thoſe Parts of it, which we hope to underſtand moſt

moſt clearly, and which we expect to make a Progreſs in, with the moſt conſiderable Advantage.

There is more Reaſon to expect Truth and Certainty in the Microcoſm than the Macrocoſm.

Since then the Microcoſm, which is, as if it were a Type and Epitomy of the Macrocoſm, lyes much more within the narrow Cope of our Senſes; ſince we can dive and ſearch into all, and the inmoſt Receſſes of it; and come nearer to thoſe Springs and Fountains, upon which all the Effects, we perceive in it, depend; we have much more ſolid and firm Foundations to proceed upon, than in any other Parts of Philoſophy whatſoever; and may

much more reaſonably hope for Certainty and Truth; beſides the Purſuit of it, muſt needs be not only more Pleaſant, but Advantagious.

Where it is eaſily attained.

And although in a Man's Body, ſome Things are much more apparent & clear than others; yet the moſt obſcure, may eaſily be ſo far explained, and underſtood; as is neceſſary and ſubſervient to ſhew the Uſe of them, and to what Ends they were deſigned.

The Heat of the Blood not obſcure in reſpect of it's Cauſe.

Amongſt thoſe that are accounted moſt obſcure, the Heat of the Blood is unfortunately one; but the Reaſon why it is ſo, is not that

that it is leſs apparent in it ſelf, but rather the Inadvertency of thoſe that ſearched into it: If poſſible ſuch great Men, as have writ concerning it, may be guilty of ſo great a Fault, which (although otherwiſe no ſmall one) is much more excuſable in thoſe, whoſe more weighty Concerns take 'em of a deeper Enquiry.

Since then, ſo many learned Men, and thoſe to whom Phyſick is not leaſt obliged, for conſiderable Improvements, have writ on this Subject; I think it not only Juſtice, but alſo Reaſonable, I ſhould ſhew upon what Grounds, and for what Reaſons I have rejected their Opinions, before I take leave to propoſe my own.

Both Antients and Moderns have differed as to the Cauſe of it.

It would be needleſs to ſpend time in Informing my Reader, that both Antient and Modern Writers have endeavoured to account for it; and it would be Information to but a few; ſince none that have made any conſiderable Progreſs in Phyſick, can be ignorant of it. I ſhall only as briefly as I can, mention the Opinions of the Antients, that it may better appear to the more unlearned, wherein they are deficient; and then, I ſhall conſider the moſt remarkable Opinions of the Moderns, that leſs competent Judges, and young Students in Phyſick, may ſpend leſs time in convincing themſelves, how far

ſar they come ſhort of explaining, the Reaſon of the Heat of the Blood.

The Opinions of the Antients very Superficial and Inſatisfactory.

Amongſt the Ancients, who wanted thoſe Improvements in Anatomy, that have been made of late, to direct them in their Judgments; ſome fancied that it proceeded from a *Calidum innatum*, or *innate Heat*; which was fixed and rooted in all the Parts of a Man's Body, before his Birth; and that This continued Heat, by communicating it ſelf ſucceſſively to the Nouriſhment of the Parts, as ſoon as it was received by them: Which indeed was ſo weak and ſuperficial an Account of

it, that it rather ſerved to pleaſe the Unlearned, then to ſatisfie the Curious, and more Inquiſitive. Others thought, that there was a ſort of Flame lodged in the Heart, which kindled the Blood as it paſſed through it. But Moderns having learnt by a further and a deeper Inſight into Mens Bodies; that the former of thoſe was rather the Effect; than the Cauſe; and by frequent Diſſections, that the Heart was altogether incapable of containing ſuch a Flame, and alſo that that which they ſuppoſed to be the *Pabulum* of it, to be clotted Blood; they have, with ſufficient Reaſon, rejected them both. Wherefore paſſing by theſe, I ſhall proceed to conſider thoſe Modern Opinions, which

which are thought moſt worthy our Conſideration.

Dr. Willis's *opinion conſidered.*

The firſt that I ſhall take Notice of, is, the Opinion of the moſt Ingenious Dr. *Willis*; who although in ſome things he hath had the Fortune to be miſtaken, with other Learned Men (the beſt being not exempt) yet for the moſt part, hath made the greateſt Improvements of any of his Predeceſſors in Theory.

Who aſſerts that there are three ways by which Liquids grow hot.

This Learned Author, in the eight Paragraph or thereabouts, of his Exercitation concerning the

the Heat of the Blood, takes Notice; that there are three Modes or Sorts of Cauſes, by which Liquids grow Hot.

Firſt, *à calido ad moto*, or by applying them to ſomething that is Hot; as when Water boyls over the Fire. *Secondly*, when Saline Corroſives mutually act upon one another, or on ſulphureous Bodies mixed with them, by an intenſe and powerful Agitation. *Thirdly*, when a Liquor abounding with much Spirit or Sulphur, takes Flame from ſome other Body. And in the next Paragraph, he ſays, that there are other ways of Calefaction; as Fermentation, Putrefaction, and Attrition; but the ſeare only obſervable in ſolid Bodies.

The

And that the Blood grows Hot by Accenſion.

The Deſign of which, is, to prove, that ſince the Blood hath not any other Body applied, to communicate Heat to it; and ſince it is not impregnated with Saline Corroſives; but is ſufficiently ſtocked with Sulphureous Particles; and ſince Fermentation, Putrefaction, and Attrition are only the Cauſes of Heat in ſolid Bodies: It muſt needs be preſerved in a continual Heat, by Accenſion of it's Sulphureous *Pabulum.*

To which it is anſwered that there is but one way in Philoſophy by which all things grow hot.

But if we do but duly conſider how Heat is promoted in all theſe ſeveral ſorts of Subſtances; it will preſently appear,

appear, that in Philoſophy, there is but one way, by which all, whether Liquid or Solid grow Hot; and if ſo, then it will follow, that whether we ſay the Blood grows Hot, by applying of a hot Thing to it, or Saline Corroſives; whether by Fermentation, Accenſion, or Attrition, it will be equivalently the ſame.

Several degrees of Heat differ only in Degrees of a peculiar Power to cauſe Heat.

To make it evident then, that there is but one way, by which all Bodies grow Hot; and that to ſay, that the Heat of it proceeds from the Application of other hot Bodies, Saline Corroſives, Accenſion, Fermentation, or Attrition, is but to expreſs the ſame thing ſeveral

ral ways; ſince they are all equivalently performed the ſame way; we are to conſider, what is the Nature of hot Bodies, and wherein their Power conſiſts; either to cauſe Heat themſelves, or to communicate that Power to others: And becauſe ſeveral remiſs Degrees of Heat, differ only in Proportion from Fire, which is the moſt intenſe; and becauſe, That is free from thoſe Masks and Clouds, which intervene it and our Senſes, when it is in more remiſs Degrees; the beſt way to underſtand the Reaſons of Heat, will be to conſider, wherein the eſſential Nature of Fire conſiſts.

Amongſt

And Fire, which is the higheſt, is rarified Matter in a ſwift Motion which Masked in different Subjects affects not our Sight.

Amongſt Philoſophers, although it is very dubious, what it is, that cauſes Fire to differ ſo much from all other Subſtances; yet it is by the Conſent of moſt Moderns, and evident from Flame it ſelf, and the manner that it deſtroys other Bodies by, that it is made up of rarified Matter, whoſe Particles are in a ſwift and powerful inteſtine Agitation, and of a peculiar Figure and Size: And if Fire be nothing elſe, but Matter rarified and in a ſwift Motion; and from that ſwift and intenſe Motion of Matter, affecting our Organs of Sence, we perceive Heat; we muſt needs conclude, that

that whatever rarifies Matter, and puts it's Parts into a brisk Motion, is the cauſe of Heat. And although according to the Diverſity of Subjects, that Heat is diſperſed through, it hath different Appearances to our Senſes, and in moſt, it's Light; which, when it exiſts ſeperately, is always joyned with it, 'tis obſcured by the Interpoſition and Mixture of other Matter; yet if Heat depends Eſſentially upon the Effects, that rarified Matter in Motion hath upon our Senſes; it is undeniably true, that Heat is cauſed only one way, Remotely and Proximately, with reſpect to Matter in Motion, and the Effect it then hath upon us, *viz.* By puting the Parts of Matter into

into a brisk Motion, to affect our Senſes with Violence enough to cauſe ſuch a Senſation.

But, before I proceed to a further Proof of what I have aſſerted, *viz.* That there is but one Way in Philoſophy, by which all Things grow hot; it being a Controverſy, whether Heat be actually in the Body that cauſes it; or whether Matter in Motion only produceth ſuch an Effect as the Senſe of Heat, upon our Senſory; although it is not requiſite, I ſhould here Publiſh my Opinion of it, yet it is neceſſary I ſhould explain what I mean, when I ſay, that Heat is only produced one Way; or that Heat is cauſed, by putting the

the Parts of Matter into a ſwift Motion; or that Heat depends on the Effects, which rarified Matter hath upon our Senſes, when it is in Motion.

But if I were here to declare my Opinion of this Point which is ſo differently held by various Philoſophers; I ſhould ſay, that as far as I can conceive of it, Heat is not actually in the Body that cauſes it to be perceived, by our Senſes, but potentially; in as much as that Body hath a Power to cauſe ſuch a Senſation.

Heat is not actually in the Body that cauſes it, but potentially, becauſe that Body hath a power to cauſe ſuch a Senſation.

And although a great many may wonder; that Fire, which cauſes Heat, ſhould not be hot

it

it ſelf; yet there is as much Reaſon to believe, that it is not; as that a Sword which will cauſe Pain, is not Pain it ſelf: For thoſe who think that Fire which cauſes Heat, is Heat it ſelf; take the Cauſe for the Effect, and affirm it to be ſo.

Heat is only a Senſation which is actually where there is Senſe to perceive it.

Beſides, Heat being only a Senſation; and it being impoſſible there ſhould be a Senſation, where there is no Senſe; it is impoſſible there ſhould be Heat, where there is only Fire, and no Senſe for it to work upon: For Heat is not a Mode of Matter rarified and in Motion; but an Effect of Matter ſo modified. But, ſay they, it is impoſſible for us to think ſo; truly

truly, if we are not directed in our Thoughts by Reaſon we may irrationally think, that Matter in Motion, which only cauſes Heat, is Heat; but if our Reaſon proceeds upon thoſe Mediums which our Senſes furniſh us with, and certainly we can on no other, we ſhall eaſily be induced to believe, that the Cauſe is not the Effect; there being a great deal of Reaſon for us to believe ſo; though, none to the contrary.

When then I ſay, that Heat is only produced one Way; I mean that there is but one Way to modify Bodies, ſo, as to make them capable of cauſing Heat; when they affect our Senſory: And when I ſay, that Heat is cauſed by putting the Parts

Parts of Matter into Motion, I mean, that a Power of producing Heat is cauſed ſo: And when I ſay, that Heat depends on the Effect, that rarified Matter hath upon our Senſes, I mean, it is cauſed by thoſe affecting our Senſes.

And becauſe, always when I have occaſion to mention the Cauſe of Heat, it would be too much Circumlocution to ſay, the Power of cauſing Heat is produced ſo, or otherwiſe; I ſhall uſe the Word Heat, ſometimes to ſignify that Motion of rarified Matter, which is ſufficient to cauſe Heat; and ſhall call that Motion, Heat in reſpect of the Effects which it cauſes.

But,

But, to proceed to a further and more evident Proof; That Heat, or a Power to produce it, is only cauſed one Way; we are to conſider, how the Motion of Particles is carryed on in all thoſe, which Dr. *Willis* calls, different Ways of cauſing Heat, *viz.* *per admotum Calidi*, Saline Corroſives, Accenſion, and even Fermentation and Putrefaction.

That Heat is only produced one way further proved.

And *firſt*, when Water is put over the Fire, and heated *per admotum Calidi*, the fine Particles of Fire penetrating the Veſſel, are imbibed into the Water, and being fettered up, and kept from flying away, by the Parts of the Liquor, put them

them alſo into a quick Motion; from whence proceeds a ſenſible Heat. In the ſame Manner, when Saline Corroſives are mixed together, the ſubtile Effluvia, of each, firſt begin powerfully to oppoſe one another; and being by that means reverberated and ſtruck back upon the Particles of thoſe Bodies, of which they are the Effluvia, put them into Motion; and as the Motion ſo begun, grows ſtronger and more violent, ſo the Degrees of Heat become more intenſe. And when a Flame is apply'd to any Sulphureous Body, the Particles of that Flame, being forcibly agitated againſt the Sulphur, put the Particles of it into a brisk and ſwift Motion; and they being by that

that means rarified and expanded, are turned into Flame. *Laſtly*, it cannot be deny'd, but that when any thing grows hot by Putrefaction, that heat either proceeds from elaſtick and fermentative Particles within, working upon one another, or from ſomething from without.

Now in all theſe ways, as he is pleaſed to call them, ſince Heat is produced by the ſame Method in Philoſophy; ſo it is reaſonable to affirm, that there is but one Way, by which all Things become hot, *viz.* By Attrition.

For Water grows hot, becauſe the Particles of Fire are mix'd with it, and put it's Parts into a

Viz. *by putting the Parts of Matter into Motion*

C ſwift

ſwift Motion: And the Effluviums of Corroſives, being very volatile and in a ſtrong and powerful Motion, by an Attrition, and grinding upon one another cauſe Heat. So alſo the Particles of Flame, by Attrition turn Sulphur into Flame: And by Motion, only not ſo intenſe, a leſs violent degree of Heat is produced in Putrefaction; ſo that in all theſe ways, Heat only proceeds from rarified Matter, put into a violent Motion by Attrition; and the conſequence of that Attrition, is Fermentation.

After the ſame manner, Heat is produced in ſolid Bodies: For when Flint and Steel are violently ſtruck together, the Sulphureous Particles being ſcattered

ſcattered and diſſolved by that Force, are put into a brisk and ſwift Motion.

But, although from hence it appears, that all Bodies whatſoever, grow hot by being put into Motion, by an inteſtin Colliſion and Attrition of Particles; and conſequently but one way: yet ſome will be apt to think, that ſince there is ſo much difference betwixt Water, Corroſive Salts, and Sulphureous Bodies; that there muſt needs be ſome difference in their way of working upon one another. *A ſeeming Objection anſwered.*

To which, all that I need to ſay more, is, That though different Bodies are differently apply'd together; yet it is evi-

dent, that they only operate by thoſe Particles that are in Motion, and which communicate Motion to each other; and one may as well ſay, that Sulphur kindled by a Flame, is made hot *per admotum Calidi*, as that Water is: For as Flame is apply'd to one, ſo the diſperſed Particles of Fire are communicated to the other.

His Compariſon of the Bloods Accenſion, with Flame conſidered.

This Learned Author, having laid theſe Premiſes to eſtabliſh a Rational Hypotheſis upon; and concluding that the Blood of a Man's Body, could not become hot any other way, but by Accenſion, goes on to compare the Accenſion of the Blood, with the burning

burning of the Flame; and becauſe, as he thinks, the ſame things are requiſite, to continue both, *viz.* *Firſt*, a free and continual Acceſs of Air. *Secondly*, a freſh ſupply of a conſtant Sulphureous *Pabulum*. *Thirdly*, a perpetual Avolition of fuliginous Recrements; he concludes that it muſt needs be kept hot by a continual Sort of Flame.

There are ſeveral degrees of Heat produced without viſible Flame.

But, he might as well ſay, that Water over a Fire, could not become hot, except it was put into a Flame, as that the Maſs of Blood, cannot grow hot without Accenſion; but ſince every Body knows that hot Water is not

Flame; there is no doubt, but that Blood may be hot without Accenſion too.

That to produce Heat, there is no need of a Flame to be always accended, is evident; ſince there are ſeveral degrees of hot Bodies, in which no Flame at all is apparent; and even Blood it ſelf, immediately as ſoon as it is extravaſated, ſeems ſo unlikely *Pabulum*, for a Flame; that Water will not ſooner extinguiſh it, but to produce ſeveral degrees of Heat in Liquids, it is ſufficient the Particles of thoſe Bodies that ſo affect our Senſes, be put into a ſwift Motion; although not into ſo high a degree as to make a Flame. So by rubbing of two Flint-ſtones together

ther moderately, is produced an evident Heat: and when they are moved againſt one another more violently, the Heat is ſtronger; and by a Colliſion yet more violent, thoſe Sulphureous Particles, that before cauſed a gentle Heat, conſtitute a Flame

He ſays, that a Flame may be continued, it ſhould always have a free Acceſs of Air; for all ſublunary Fire, and eſpecially Flame is compoſed of Sulphureous Particles, breaking out of the combuſtible Matter; and of Nitrous Particles which always abound in the Air, and theſe Nitrous Particles, he ſays, are ſo neceſſary to the production of Flame, that in the *Summer*, if the Sun does but ſhine

upon the Fire, by driving it back and diſſipating the Nitre, it extinguiſhes it: Whereas, on the contrary if it be ſupply'd with a ſufficient Quantity, it burns more clear and brisk.

Nitre makes up no part of the Flame.

Indeed, it is ſo manifeſtly certain, that Fire burns briskerand fiercer, when it hath a ſufficient quantity of Nitre about it, than when it hath not; that to contradict it would be to deny what is ſenſibly apparent; but yet it does not therefore follow, that Nitre makes up part of the Flame: For Sulphur and Oyl will flame as violently in the *Summer* as in the *Winter*, though Wood and Coal, and other

other combuſtible Matter will not.

Beſides, if Nitre made any Part of the Flame, though it might readily mix with the outward ſide of it, I would willingly underſtand, how when a Flame is two or three yards Diameter, it is poſſible for it to be mixed with the middle of the Flame; which we perceive is more violent than the Borders of it, where Nitre abounds.

But, the Reaſon why Flame will not burn without ſome degree of Nitre, is not that it makes up any Part of it, but becauſe the Particles of Fire are in ſo very ſwift and violent a Motion,

The Nitrous parts of the Air promote Flame by keeping its Matter from diſperſing too ſoon.

that they would immediately be diſperſed and fly away; if the Nitrous Particles of the Air did not prevent them, by cloſing round about them, and keeping them up to a Center; by which means Flame is not only made of a longer continuance, but it's Power of heating us is more violent; thoſe moving Particles being reverberated, and working mutually on one another, ſo as to encreaſe their Motion, and conſequently their Effects.

And as the Rays of the Sun, collected into a Point by a Burning-Glaſs, makes 'em more violent, ſo do the Nitrous Particles encreaſe the Vigour of the Flame: And again, as Banks caſt up about a Spring prevent the

the Water from ſtreaming away till a greater Quantity is gathered together, and it breaks out violently; ſo are the Particles of the Fire heaped up, and kept in till their Motion overpowers the Preſſure of the Nitre.

But Nitre does not only by reverberating the Rays, collect a great Number together, and by that means encreaſe their Vigour; but alſo by inverting their Motion, turns them back again upon, and cauſes them by ſtriking againſt, the combuſtible Matter to diſſolve, and put the Particles of it into Motion ſooner, wherefore it burns more briskly, and is conſum'd in leſs time.

And

And this is the Reaſon that Fire burns better in the *Winter*, than the *Summer*: For in the *Summer* for want of a cloſe condenſed Nitrous Air, to bind up and collect the Particles of Fire, they are diſſipated and ſcattered immediately; but in the *Winter*, being as if it were yok'd and lock'd up together, they affect our Senſes more vigorouſly.

Wherefore Fire burns better in the Winter *than in the* Summer.

To prove, That Nitre is Part of the *Pabulum* of Flame, he inſtances an Experiment, from the Famous Mr. *Robert Boyl*, *viz.* That a lighted Candle being put into a large

Why a Candle in a Glaſs-Globe is extinguiſhed by extracting the Air.

large Glaſs-Globe, and the Globe being ſtoped, as ſoon as the Air is ſucked out, the Flame expires. But this is ſo far from proving, that the Air is part of the *Pabulum* of Fire, that it is the ſtrongeſt Proof of what I juſt now ſaid: for as long as the Particles of the Air cloſing about the Candle, keep all the Rays together; and by inverting their Motion, cauſe them to turn upon the Fat, that they may, by diſſolving of it, and putting it's Parts into Motion, turn it into Flame, ſo long it burns; but as ſoon as the Nitre is exhauſted, the Rays being immediately diſperſed, and ſcattered by their own agility; fly away from, and ceaſe to convert the remaining

Part

Part of the Fat into Flame; and that which makes more for what I have ſaid, is, that as the Air is gradually drawn out, ſo the Flame is gradually diminiſhed: For when there is leſs Nitre to oppoſe the Motion of the Rays, they are ſooner diſperſed; and the Nitre by giving them that liberty, leaves leſs flame about the Candle.

His Compariſon of extinguiſhed Flame, compared with the Death of an Animal conſidered.

He ſays further, as Flame is extinguiſhed by taking away the Nitrous *Pabulum* of it; ſo when the Breath of an Animal is ſtop'd, it dyes not ſo much becauſe it is choaked by a Retention of fuliginous Recrements, as by rob-

robbing the Blood of the Nitrous *Pabulum.*

How an Animal comes to die by ſtoping Reſpiration, I ſhall hereafter give an Account, when I ſpeak concerning the Uſe of the Lungs; in the mean time, I ſhall here make it evident, that the Nitre of the Air, is ſo far from promoting the Heat of the Blood; that the leſs Nitrous the Air is the hotter it grows.

Nitre does not promote the Heat of the Blood but rather depreſſes.

This is ſufficiently manifeſt, if we do but take our Breath through a warm Woollen Cloath, which imbibes, as if it were, the Nitre; for we ſhall be ſo far from being cooler for it, that in warm Weather, when

when our Bodies are a little prediſpoſed, it cauſes us to ſweat, whereas if Nitre promoted the Heat of the Blood, we ſhould rather be cold, the Flame of the Blood according to him being extinguiſhed for want of a Supply of Nitrous *Pabulum.*

But, although this would not be a ſufficient Argument to convince us; yet a cold Winter and a hot Summer would be Arguments ſtrong enough; for we always find, that in the Winter, when the Air is full of Nitre, we are much more cold, then in the Summer when in the Heat of the Sun, we want that Supply of Nitre: From whence it ſufficiently appears, that Nitre does not contribute to the Heat

Heat of the Blood, but rather depreſſes it.

For in Liquids the volatile Parts are ſufficiently oppoſed by the Parts of the Blood and kept from flying away.

Neither, in Liquids is there any accenſion as there is in Flame, for Nitre to lock up and keep the Heat from diſperſing; for Water will be Hot, though it be placed in the Middle of a Fire, where no Nitre can come near it; the Particles which make up that Liquid Subſtance, being ſufficient to reſerve thoſe Particles of Matter, which cauſe Heat upon our Senſory, from flying away ſo ſoon, by intangling and ſettering them up.

The

Blood may grow hot without a Sulphureous Pabulum.

The ſecond Thing, that he ſays, is requiſite to preſerve Heat, is a continual ſupply of Sulphur. That Flame cannot be continued without a Supply of combuſtible Matter, I do not deny, yet we are certain, that Blood may grow Hot, without ſuch *Pabulum*; for the Blood of Horſes, and other Beaſts, is ſo far from being ſupplyed with a Sulphureous *Pabulum*, that nothing is leſs combuſtible then Graſs and Water, which are their conſtant Food; and which have different Effects upon our Senſes from Sulphur; and the daily Food we eat, is ſo far from kindling a Flame, that

that it would preſently extinguiſh it.

His Compariſon of the Recrements of Flame and of Blood conſidered.

The *Third* and laſt Thing, he ſuppoſes, requiſite to continue a Flame is that the Fuliginous Recrements be carried of; and as Flame requires a continual Avolition of it's Recrements; ſo does the Blood, by the Branches of the *Trachea* and the Pores of the Body.

Which appears widely inconſiſtent.

That Smoak and Flame are, as if it were, inſeperably joyned together; and that a ſubacid Balſamic Juice continually ſweats through the inward Coats of the *Trachea*, and a ſaltiſh

ſaltiſh *Serum* through the Pores of the Skin is moſt certain; but in the carrying on of each of theſe *Phænomena*, there is a very wide difference; for in an Animal that Sub-acid Balſamick Juice, which ſweats through the inward Coats of the *Trachea*, is deſigned to moiſten the Cavities of it, to prevent them from drying and becoming uſeleſs, and partly to preſerve them from the ſharpneſs of the Nitrous Particles of the Air: and in like manner, the Skin is continually watred with that *Serum*, to preſerve it from withering and becoming too dry; and though

Firſt, *becauſe that Juice that ſweats through the Coats of the Trachea and the Skin is not* Recrementitious.

though theſe Humours are not ſucked up again into the Blood, yet that is not becauſe they are Fuliginous Recrements, and Uſeleſs Parts of the *Serum* of the Blood; but becauſe, ſince thoſe Parts muſt needs be kept from drying; it would be impoſſible for Veſſels to be ſo framed as to receive and return them to the Maſs of Blood again: For the outward ſide of thoſe Veſſels would ſtill be dry and want *Effluviums*, to moiſten them *ad infinitum*. But the Fuliginous Effluviums of Fire are altogether Recrements and Uſeleſs in reſpect of Fire.

And the Fuliginous Effluviums of Fire are Recrements.

Beſides, the Effluviums of the Maſs

Secondly, becauſe the former if not carried of encreaſe it. Maſs of Blood, if ſtopped, are ſo far from depreſſing and diminiſhing the Heat of the Blood; that they encreaſe it ſo much; that they preſently put thoſe that have prediſpoſed Blood into violent Fevers:

But Smoak extinguiſhes Fire. But if the Smoak of a Fire, or of a Candle, be reflected upon the Flame, it is preſently extinguiſhed.

Smoak is not altogether an Effluvium of Flame. But it is a Queſtion, whether Smoak be altogether an *Effluvium* of Fire: whereas, no Body doubts, but that the Moiſture, which ſupplies the Lungs and inſenſible Tranſpiration is ſeperated from the *Serum* of the Blood: For Smoak

Smoak, as I conceive, is made up of the Nitre of the Air, fixing the Particles of the Flame, together with the Aſhes of the Fuel, that are raiſed and forced up by the quick and violent Motion of the Fire; which I believe is carried on after this Manner,

Smoak thus compounded.

The Particles of the Fire, being in a very brisk and violent Motion, endeavour to expand, and powerfully to fly away, from the Fuel that ſupplies them; but the Nitre of the Air, ſtrongly oppoſing them, partly preſſes them back, till their Motion being increaſed and more intenſe, they violently ſcatter themſelves in the ambient Air, both amongſt the Duſt and Aſhes

Aſhes of the Fuel, hurried along with them by their Motion and the Particles of Nitre: By which means, they looſe moſt of their Vigour, and are more eaſily overpowered by the Nitre; and being fixed and joyned with thoſe Aſhes, makes up that which we call Soot; which the longer it lyes together, grows more Bitter, the Sulphureous Particles of the fixed Flame, being by an Inteſtine Sort of Motion, exalted, and overpowering the more dull and effete Parts of Matter.

From whence it appears, that Soot is not altogether a Recrement of Fire; but is made up of effete Aſhes, Fire and Nitre.

But though Soot were wholly

ly a Recrement of Fire, yet it does not follow, that that Moiſture, which ſupplies the Lungs, is a Recrement of the Blood, though it were to be called a Recrement: For it is ſeperated, as a Part of the Serum and Lympha, and not of the Blood.

FRom what I have ſaid, I think, it plainly appears, that neither the *Simile* he uſes, is in any conſiderable Circumſtances agreeable; nor can he from thence deduce the Reaſon of the Heat of the Blood; and being led as if it were by a Neceſſity, in Anſwer to his Opinion, to conſider the Nature

of Flame, and the manner of it's Production, more then I otherwiſe ſhould have done; I ſhall beg leave to make a ſmall Digreſſion here, which though it may ſeem foreign to a Diſcourſe of the Heat of the Blood; yet it may not be improper, after what I have already ſaid of Fire, to endeavour to give a Reaſon, why Flame, when it is left to it's own Liberty, always aſcends.

A Digreſſion in which is given the Reaſon why Flame Aſcends rather then Deſcends.

To underſtand then the Reaſon, why Flame always aſcends, we muſt again remember, that Fire is, for as much as appears to our Senſes or Reaſon, a light rarified Body, whoſe minute and ſubtile Particles, are in a ſwift Motion, and in ſome

ſome meaſure pinned in, by the ambient Air.

Now though the ambient Air thus preſs upon it on every ſide; yet the Particles of Flame, being in too ſtrong a Motion, and alſo too ſubtile to be totally reſiſted, and altogether confined; muſt needs break out that way, which it forces moſt eaſily, and where it is leaſt powerfully reſiſted.

Which is becauſe it hath leſs Oppoſition in it's Motion that way.

That Flame is only a rarified Body in ſwift Motion, I take for granted; and that it is preſſed upon on every ſide by Air, none ſure will deny; and it muſt needs be moſt reaſonable for us to believe, that it will be ſubject to ſpread and expand

it ſelf that way it finds the leaſt reſiſtance: Therefore all that I need to prove, is, that Flame expoſed to the open Air, finds leſs reſiſtance in Aſcending then Deſcending.

That Flame finds leſs reſiſtance in Aſcending then Deſcending, will eaſily be proved, if we will but allow, what is beyond Contradiction, *viz.* That the more ſolid and compreſſed any Body is, the more Powerfully it repels thoſe Bodies that move againſt it; which plainly appears, if we ſtrike two peices of Mettle together, *viz.* Lead and Iron, for at the ſame time, that Lead eaſily yields to the Impreſſion of the Iron, it as powerfully reſiſts the former.

If then, the Air, the nearer

it

it is to the Center, be more Solid and Firm, conſequently it will reſiſt the motion of Bodies that ſtrike againſt it, with greater Vigour; and when the Particles of Flame are forcibly driven againſt it, they, being more ſtrongly reſiſted, by that Air, which is below, than the Air above, with leſs difficulty make way for themſelves upward, and ſo aſcend.

Becauſe the Air the nearer to the Center makes ſtronger Oppoſition than that above.

That the Air, the nearer it is to the Center, is thicker and more compact, conſequently will be abler to reſiſt the Notion of the Flame; we have a great deal of Reaſon to believe, if we conſider, what a vaſt and unaccountable Weight of incum-

bent Air, preſſes upon it; for, as in a Pillar of Stone, the nearer to the Foundation, the harder it is to force a Stone out of it, becauſe it is held faſter by the weight of thoſe that lie upon it; ſo we muſt needs conceive, that thoſe Particles of Air next the Center, will be made more compact and able to reſiſt the Flame by the weight of thoſe that lie upon them.

Which is proved by theſe Experiments.

But to prove it more evidently, *viz.* That the Air next to the Center, makes a ſtronger Reſiſtance; I ſhall produce a common, yet very remarkable, Experiment, which is this. If a Bladder be blown full of Air, at the bottom of the

the Mountain *Teneriff*, and be carried up to the Top of that Hill, it will preſently burſt: The Reaſon of which is plainly this, a great quantity of Air at the bottom of the Hill, being preſſed and ſqueezed cloſe together, by the weight of all that condenſed Air, that lies upon it, the Springs of it being by that means, as if it were wound up, and made more compact, as ſoon as that weight is wanting to keep them cloſe together, at the Top, they fly open and expand themſelves, to a more lax and open Conſtitution of Parts; which Reaſon is confirmed by another Experiment, *viz.* By blowing a Bladder full of Air at the Top of the ſame Mountain; for as it is brought

down to the bottom of the Hill, it gradually ſubſides; and though it was as full as it could be blown at the Top of the Hill; yet at the bottom, it will ſeem not near fully diſtended, the Spring of the Air that was above expanded, being now preſſed together by the weight of the Air above it.

It is alſo proved by the Expanſion of Gunpowder.

Another Obſervation, which I ſhall bring, for a Confirmation of it, is, That a Muſket ſhot off at the Top of that Hill, makes no conſiderable Noiſe, compared with the Sound it cauſes at the bottom. The Reaſon of which difference can be no other, but this, that the Air being more compact and ſolid below, cauſes the Colliſion

Colliſion of the ſmall Particles of Matter, to be more violent, by a ſtronger Oppoſition; and conſequently the Sound is by that means louder.

Beſides, the Particles of expanded Gunpower fly away and diſſipate themſelves, a great deal more eaſily above then below; which confirms what I have ſaid before, of the Reaſon, why Nitre is beneficial to the maintanance of Flame; for if the Air, when it is more condenſed, binds up and cauſes the Particles of Fire, to work more powerfully upon one another; and by that means a ſtronger Colliſion of Particles; and if when it is leſs condenſed, it more eaſily yields to them, and gives them Liberty to fly away

with leſs Reſiſtance; it muſt needs be granted, that the Office it performs here below, in reſpect of Flame, is, to keep it's Parts from flying away too eaſily.

But for a further Proof and Confirmation of the Reaſon I have given, why Flame flies upwards, *viz.* Becauſe the Air yields more readily to it's Motion upwards, being leſs compact above then below; I ſhall produce two or three Inſtances, which prove, that if it had but leſs Liberty to aſcend, by the Oppoſition of ſome other Body then to deſcend it would as naturally fly downwards as it does now upwards, when it is otherwiſe; and I ſhall alſo prove,

prove, that if it had but an equal Reſiſtance on each ſide, it would expand orbicularly.

And *Firſt*, that if Flame had but an equal Reſiſtance from ambient Bodies on each ſide, it would expand Orbicularly, will be proved by this Experiment, *viz.* fill a hollow Globe with Gunpowder, one ſide of which is a little thinner than the other; and whatever way that thin ſide is turned, whether down, upwards, or horizon-ward, the Gunpowder will expand, and break out that way.

Secondly, to prove that if there were but more liberty for the deſcent than aſcent of it, Flame would naturally fly downwards, we need but ſhoot

a Gun off with the Mouth downwards; for the explauded Gunpowder finding an open and eaſy Paſſage downwards, and being reſiſted upwards, and on each ſide, it naturally deſcends.

But ſome perhaps that do not throughly underſtand, why a Thing is ſaid naturally to aſcend or deſcend, may be unwilling to believe, that when a Gun is ſhot downwards, the Motion of the Flame is a natural Motion, but may rather think it Preternatural.

The Motion of Flame downwards is a natural Motion in Philoſophy.

But that it may appear, that it is as truly a natural Motion in Philoſophy, as the aſcending Motion of it, I ſhall con-

conſider, why Flame may be ſaid naturally to aſcend.

Flame then is ſaid naturally to aſcend, becauſe it is the Nature of it, for the moſt Part to do ſo, which is as much as to ſay, the Nature of Flame inclines it to aſcend; how the Nature of it inclines it to aſcend, I have already ſhown, and that there are the ſame Reaſons, why the deſcending Motion, ſhould be termed Natural, will eaſily be proved; for as it is natural for it to aſcend, as long as it hath only the Air to oppoſe it's Motion, ſo it is it's Nature to deſcend, when the Order of Oppoſition is changed; and the latter is as much a natural Motion, as the former; all that diverſifies the tenden-

cy

cy of Flame, being thoſe accidental Circumſtances which are about it; and as a Ball, caſt againſt the bottom of a Room, rebounds upwards; and when it is thrown againſt the top of it, as naturally flyes down; ſo Flame, being in a brisk Motion, naturally flyes up or down, as the Parts of Matter it ſtriks againſt reſiſt it, and cauſe it to fly back from them.

Diemerbroek's Opinion examined.

HAving made this ſhort Digreſſion, I ſhall proceed next to examin *Diemerbroek's* Opinion; who thinks that the vital Spirit, by reaſon of it's Volatility, always

always endeavouring to fly away, does continually agitate those grosser Particles of the Blood; with which it is entangled and detained from flight; and is diversly vibrated and beat back, and so the whole Mass being kept in a continual fermentative Motion; there is a Heat produced in it, which in a greater Agitation, is greater, &c. And so differs, according to the different Degrees of Agitation.

All that I shall, or need to take Notice of here, is, that that Agitation of Particles, which he says, causes the Heat of the Blood, rather produces a Sensation of Heat, by affecting our Senses, in their Motion, than produce that, which we call Heat

Heat in the Blood. But to know the true Reaſon of the Heat of the Blood, we muſt underſtand how thoſe Particles are put into Motion; which by affecting our Senſory, cauſe ſuch a Senſation. So that he ſeems to me to ſay no more, then that that which hath a Power to cauſe Heat, is the Cauſe of that Power, when he ought in order to explain the Heat of the Blood, to have ſhown from whence that Power proceeds, the Reaſon of which, I ſhould have taken in ſome meaſure, for the Reaſon of the Heat, potentially in the Maſs of Blood; but from what he hath ſaid, it appears, that he hath not explained the true Reaſon of the Heat of the Blood

ſo

ſo plainly, that I need ſay no more againſt it.

Dr. *Henſhaw* thinks, that the Diſſimilitude betwixt the Chyle and Blood is ſo great, that it becomes immediately the Cauſe of an extraordinary Ebullition, upon their mixture together, which is very much increaſed by the reciprocal Motion of the Lungs; whereby the Blood is wrought into a froth, by that time it gets into the left Ventricle of the Heart. Which ſudden Exceſs of Heat, he thinks, not unlike what happens upon the mixing of ſeveral Chymical Liquors together; for the Heat often

Dr. Henſhaw's *Opinion conſidered.*

often becomes ſo great, that they often endanger the Veſſels that contain them.

But he might as well have ſaid, that there is ſo great a Diſſimilitude betwixt hot Blood and cold Milk, that as ſoon as the Milk is mixed with it, it will cauſe an extraordiary Ebullition; and that by expoſing them to the Air, & running them through Pipes, the Heat would increaſe; but this is ſo plainly falſe, that it needs no other Arguments, but Reflection to convince the weakeſt Reaſon.

And he might equally as well conclude, that Water would kindle a Fire, and encreaſe the Flame of it, becauſe Oyl will, as that Chyle will put the Blood into a Heat, becauſe Oyl of Tur-

Turpentine and Spirit of Wine will grow hot when mix'd together, but the Concluſion being manifeſtly abſurd, I ſhall in the next Place, endeavour to ſhow the Reaſon of the Heat of the Blood as evidently as poſſibly I can.

FROM what I have already ſaid, in Anſwer to Dr. *Willis*'s Opinion, it ſufficiently appears; that, whether we ſay, the Blood grows hot *per admotum Calidi*, Accenſion, or any other way, it is no more then to expreſs the ſame Thing ſeveral ways; or to make Words

different in Sound, to expreſs one and the ſame thing.

Antient and Modern Writers have rather diſputed about the Uſe of Words, than much difference obſervable in their Opinions.

But as all that have writ on this Subject, have made choice of a different Name to ſignify the Heat of the Blood by; whilſt ſome would have it done by Accenſion, others by Attrition, &c. ſo they have by that means, rather diſputed about Names and Words, than any real and fundamental Difference in their Opinions. I ſhall not here enter into a diſpute, whether the Blood when it becomes hot, may moſt properly be ſaid to grow hot, or it's Heat expreſſed by any one of thoſe Titles, they have been

been pleaſed to ſignify it by; for as in diſcourſing about the conſtituent Parts of a Man, it is not neceſſary to fix any Name upon that Man; but whether it be *Thomas*, *Robert* or *William*, the conſtituent Parts of him, if he be a perfect Man, will ſtill be the ſame; ſo in diſcourſing concerning the Heat of the Blood, and conſidering the principal Cauſe or Agent, and the more remote and acceſſory Cauſes; it is no matter at all, whether the Conſequence of theſe Cauſes be ſignified by the word Accenſion, Attrition or Fermentation; becauſe the Difference of the Title, does not at all diverſify the Action.

But if any one would rather ſignify the Heat of the Blood, by

by any of theſe different Words, I ſhall be equally pleas'd with them, or any of them; provided they all meet, in the Matter ſignified by them, and do not deny that which ſeems to be true: That the Heat proceeds from a ſwift inteſtin Motion of it's Particles. Which Motion is the Reaſon why it affects our Sentory, ſo as to cauſe a Senſation of Heat.

The Reaſon why Heat affects our Senſory does not ſhew how it comes by that Power.

But as the Reaſon, why it affects our Senſory ſo, is not ſufficiently ſatisfactory to explain what is the Cauſe, and how it comes by that Power of cauſing ſuch a Senſation. In making an Enquiry into the Cauſe of that, I

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ſhall beg leave to make Uſe of that Word, which I think to be moſt expreſſive, *viz.* Fermentation.

The Blood grows hot by Attrition the Conſequence of which is Fermentation.

For ſince in every mechanical Action, there is an Agent and a Patient; and the Agent operates upon the Patient, by moving powerfully againſt the Parts of it: And in that Motion, the Parts of the one ſtrike againſt, and rub upon, the other; ſo far it may be called Attrition: And if by the force of the Agent, the Motion, and conſequently Attrition, be more violent; and the conſequence of that Attrition, be a Production of a Power to cauſe a Senſation of Heat;

Heat; ſo far it may be called Fermentation: If then in cauſing the Heat of the Blood, there be ſuch a Motion and Attrition, and the conſequence of it be Heat; we may properly ſay, the Blood grows hot by Attrition and Fermentation.

Attrition and the conſequence of it both to be ſignified by the Word Fermentation.

But becauſe, to ſignify the Heat of the Blood, by Attrition and Fermentation, would be needleſs; I would ſignify all that Action by Fermentation: And when I ſay, the Blood grows hot by Fermentation, I would be underſtood to mean and ſignify both that Attrition of Parts, which is the Cauſe of Fermentation; and alſo Fermentation, which

which is the consequence of Attrition, yet if any one would rather say, it grows hot by Accension; they have my assent, provided they mean thereby, not so high a degree of Heat, as is usually signified by that Word; but since it sounds rather too harsh, and implies too high a degree of Attrition and Fermentation than that, which is commonly in the Blood; I more willingly make choice of the former, *viz.* Fermentation.

How far the Heat of the Blood proceeds from Pressure and Mixture.

And since I have said thus much of the Use of Words, applyed to signify the Heat of the Blood; I shall here take Notice, of what was by way

of Diſcourſe told me, by one, to whom I communicated, in ſome Meaſure, my Notion concerning the Heat of the Blood; which was this. He ſaid he thought he could prove that it was done by Mixture and Preſſure; and that he could explain the Heat of the Blood, by that Notion.

I ſhall here conceal the Authors Name, becauſe he hath not made it public upon this account, though upon ſome others to very little purpoſe; and becauſe he told me, he intended to publiſh it, I ſhall for his ſatisfaction, and alſo the ſatisfaction of thoſe, to whom he hath communicated it, ſay; that as I have ſhewn, that in mechanical Actions there is a Motion,

and by that Motion there muſt be implyed a Mixture, to any one that doth but underſtand the Circulation of the Humors in a Man's Body; and it will conſequently follow, that where there is a Mixture, and a Motion of Humors, there muſt needs be alſo an Attrition of Parts, ſo moved; which Attrition implies a Preſſure: For there can be no Attrition, without a Preſſure; tho' Preſſure does not imply Attrition. This is all he told me, and conſequently all that I can Anſwer; but, for as much as I cou'd gather, from the remaining Part of his Diſcourſe, the moſt Eſſential Part of his Notion; but from what he ſaid, it appearing not what Preſſure he meant,

that is, a Preſſure of what, whether of the Particles of Blood with one another or not; and it being plain, that he did not believe, that Animal Spirits circulated through the Nerves; I not only concluded that his Preſſure was only of the Particles of Blood; becauſe there are none other except *Serum* to mix with it; but alſo, that what he had to ſay for it was rather about the Uſe of Words then any thing elſe; and therefore, I have ſhew'd him how far his Words are ſignificant in my *Hypotheſis*.

But Words, whereby we ſig-

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nifie the Heat of the Blood, being nothing at all to the Cauſe of it; and to diſpute, whether it may be called Accenſion or Fermentation not at all informing, what are the Principal or Acceſſory Cauſes of it; I ſhall proceed to ſhew, how it is begun and carryed on; and by what: That is, what Humors are Active, and what Paſſive, in producing Heat, or a Power to Heat; and how they are ſo, and after what manner; as alſo where they chiefly operate.

To diſpute about Words is not material in an Enquiry after the cauſes of Things.

And that it may appear, we are to conſider; that the material and corruptible Part of a

The whole Body is made up of Veſſels and Humors contained in them.

Man, in which, the immaterial and immortal is lodged, is made up of Solid and Liquid Parts; the Solid Parts are all thoſe Veſſels, that make the Body a curious contrived Vaſcular Engin; which are filled with, and actuated by, Liquids, and in which, they all circulate: And as thoſe Veſſels carry different ſorts of Liquids; ſo they are called by different Names; Veins, Arteries, Nerves, *&c.* Through the Arteries and Veins, the Maſs of Blood continually circulates, and Animal Spirits through the Nerves.

By what means the Spirits and Blood are mixed in order to a Fermentation.

The Veins and Arteries, being, as if it were, both rooted and ſpringing from the Heart, are branched

branched up and down the Body; both through the External as well as Internal Parts, except thoſe, that the *Vena Portæ* ſupplyes; and the Nerves, taking their Original from the Brain and ſpinal Marrow, are diſperſed through the whole; and meeting with the capillary Terminations of the Veins and Arteries, they being interwoven one with another, terminate all together; and, as I Metaphorically expreſſed it, in my Treatiſe of *Muſcular Motion*, all terminate in ſmall Glands; in the Cavities of which both through the ſubſtance of the Muſcles, as well as the Internal Parts, the Arteries lay down Blood, and the Nerves either mediately, or immediately Animal Spirits;

and having there alſo proved, that a ſubtile Liquor, made and prepared in theſe Glands by Fermentation, was according to the different degrees of Spirits, ſent there by our Appetite, not only ſubtilized but thruſt out by a ſucceſſion of Matter into the Fibers, and circulating through them, diſtends 'em, and by that means contracts the Muſcles; and there alſo having ſhewn, that the Fermentation was cauſed, by a mutual Conflict of the Blood and Spirits; I ſhall now in this Treatiſe endeavour to explain from that mutual Conflict, the Heat of the Blood.

Animal Spirits demonſtrated.

And becauſe ſome, as yet doubt, whether Animal Spirits circulate through

through the Nerves, or not; and others, though they are willing, and find it neceſſary to grant; that Spirits do really run through them; yet profeſs that they cannot be demonſtrated. I ſhall before I proceed to ſhew how the Heat of the Blood is cauſed, endeavour to demonſtrate thoſe Spirits; and prove, that they circulate through the Nerves, as plainly as we can by the help of our Reaſon, and the Teſtimony of our Senſes, demonſtrate any, and the moſt apparent Things whatſoever.

In the ſubſtance of the Brain.

For any one, that does but look into the Subſtance of the Brain, I think, needs neither doubt, nor be

ignorant what the Animal Spirits are, nor of their Nature, which appear as manifeſtly as the Humors of a Mans Body.

Viz. that Mucilaginous oily Moiſture which we call Brains.

But, perhaps it will be a hard Task to perſwade ſome, that that oily and clammy Moiſture in the Brain, is Animal Spirits; ſince it ſeems, as ſome ſay, to be as groſs a Subſtance, as any Liquid in the Body.

An Objection Anſwered.

To this I anſwer, that if we take Animal Spirits, or that Moiſture in the Brain, and compare it with coagulated Blood, it is much more fine and pure, and not half ſo tough and clammy; whereas, if it were

were a more groſs and ſluggiſh Body, it would be a great deal more Viſcid and Phlegmatick.

That it is the moſt ſpirituous Part of the Blood and conſequently Animal Spirits proved.

But if we further compare the Taſte of the Brain, with the Taſt of the Blood, it will be evident; that that ſweet Subſtance is the Spirit of the Blood; and conſequently that it is Animal Spirit; For as the Blood is a ſweet Maſs, inpregnated with diverſe ſorts of Salts, and Phlegmatick crude *Serum*; ſo the ſubſtance of the Brain is moiſtened with an oyly ſweet *Salino-Sulphureous* Maſs, free from thoſe indigeſted Dregs, that ſwim along with the Blood; being ſeparated from thoſe Impurities

ignorant what the Animal Spirits are, nor of their Nature, which appear as manifestly as the Humors of a Mans Body.

Viz. that Mucilaginous oily Moisture which we call Brains.

But, perhaps it will be a hard Task to perswade some, that that oily and clammy Moisture in the Brain, is Animal Spirits; since it seems, as some say, to be as gross a Substance, as any Liquid in the Body.

An Objection Answered.

To this I answer, that if we take Animal Spirits, or that Moisture in the Brain, and compare it with coagulated Blood, it is much more fine and pure, and not half so tough and clammy; whereas, if it were

were a more groſs and ſluggiſh Body, it would be a great deal more Viſcid and Phlegmatick.

That it is the moſt ſpirituous Part of the Blood and conſequently Animal Spirits proved.

But if we further compare the Taſte of the Brain, with the Taſt of the Blood, it will be evident; that that ſweet Subſtance is the Spirit of the Blood; and conſequently that it is Animal Spirit; For as the Blood is a ſweet Maſs, inpregnated with diverſe ſorts of Salts, and Phlegmatick crude *Serum*; ſo the ſubſtance of the Brain is moiſtened with an oyly ſweet *Salino-Sulphureous* Maſs, free from thoſe indigeſted Dregs, that ſwim along with the Blood; being ſeparated from thoſe Impurities

purities in the cortical Part of the Brain, now if a Spirit partakes of the Nature of that Body, it is ſeparated or drawn from, this is an Argument ſtrong enough to convince any Rational Man, that that Moiſture is the Spirit of the Body; ſince we learn by our Taſte, that it is the pureſt and moſt refined Part of the Blood; as a Spirit ought to be.

That oyly Subſtance is capable of performing all thoſe Actions which we can ſuppoſe the Animal Spirits do.

But ſome think it too groſs a Humour, to perform all thoſe Actions, which they think, the Animal Spirits do; yet if they grant that the Maſs of Blood is the *Pabulum* of the

the Animal Spirits, as I think none can deny; ſince any conſiderable Evacuation of it, preſently ſinks and diminiſheth them, then it will be very manifeſt, that thoſe Spirits are able to perform all thoſe Actions, that we can truly ſuppoſe Animal Spirits to do; for if by withdrawing that ſweet *Viſcid Pabulum*, that ſweet oyly Mucilaginous Moiſture in the Brain, be diminiſhed, and upon that Diminution the Animal Spirits are preſently leſs vigorous; and on the contrary; if by enriching the Blood, and conſequently encreaſing the ſtock of Animal Spirits, the Actions of the Body as well as of the Mind be ſtronger, we muſt conſequently

quently believe, that they are moderately performed by them; when that oyly Subſtance, neither too plentifully abounds, nor is too much ſpent and conſumed.

Another Objection *anſwered.*

But ſome People will not believe, That to be Animal Spirit; becauſe they ſay, they cannot get ſo much as one drop of it out of the Veſſels.

To which I *anſwer*, that if they deny it to be Animal Spirits, becauſe they cannot gather it in drops; by the ſame Reaſon they may deny Blood to be Blood, becauſe in ſmall capillary Veins, when it is coagulated, it cannot be dropped out: For not only the capillary

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ſanguiferous Veſſels are ſo ſmall, that they cannot be ſeen by good Microſcopes, but alſo the Nervous Fibers are ſo extreamly diminutive and fine, that they have been computed to be fourſcore times as Fine as a Hair, and conſequently the Liquor contained in each muſt be ſo little, that five or ſix Hundred Veſſels muſt be joyned together, to make one Drop; ſo that, being ſeparated and divided into very ſmall Portions, by the Intermixture of the Veſſels, it is no ſooner expoſed to the Air, but is immediately chill'd and coagulated.

Which we may more eaſily believe, when we take Notice, how thin and fluid the Maſs of Blood is, as long as it is in a ſwift

ſwift and conſtant Circulation, that if a capillary Veſſel be but pricked with a ſmall Pin, Blood immediately ſpurts out; yet how ſoon when expoſed to the Air, does it thicken and coagulate, though it be expoſed in great Quantities; ſo that one would ſcarce think it fit to move through Veins ſo ſmall, that they cannot be diſcerned by the beſt Microſcopes; much rather then may the Animal Spirits, whoſe Portions are ſo incomparably diminutive, be forthwith chill'd and thicken'd, when they immediately, as ſoon as they are expos'd to the Air, are almoſt equalled with Particles of Nitre.

But

But be it never ſo evident, that theſe are the Animal Spirits that are in the Brain; yet moſt deny them a conſtant and free Circulation. But ſince we ſee, that Blood, which is much more groſs and thick, than Animal Spirits, when coagulated, as long as it is in a quick and brisk Motion, can move through the ſmalleſt Capillaries, we have great Reaſon to believe that the Animal Spirits would move much more ſwift, when ſeparated and preſerved from the Nitre of the Air; and although they immediately thicken, when expoſed to the Air; yet are they much more thin

That theſe Spirits are in a conſtant Motion proved.

thin and liquid, when in Circulation.

But it is not only evident, that theſe Spirits are in a continual Motion, but alſo highly neceſſary: For either they muſt be in Motion, or ſtagnate; and if they ſhould ſtagnate; they would in a ſhort time corrupt and putrify. Beſides, ſince there is a continual and conſtant Supply, ſeparated in the Cortical Parts of the Brain, there muſt be a continual Decreaſe, or otherwiſe, there would be no room to receive them, which Evacuation we can rationally imagin to be no other way, but through the Branches of the Nerves; and alſo, becauſe we perceive the Effects of them in the Muſculous Parts.

From

From hence it appearing that that oyly Subſtance in the Brain is ſeparated from the Maſs of Blood; being the ſweeteſt and moſt ſpirituous Part of it; and that it muſt needs circulate continually through the Nerves; I ſhall now conſider the Nature of it, that we thence may gather more clearly the Manner of it's Operation.

The Nature of the Animal Spirits conſidered.

Which preſently appears, if we do but conſult our Taſte, the Taſte of it being oyly, ſweet and mucilaginous, that Subſtance being made up of the moſt volatile ſulphureous and ſalt Particles of the Maſs of Blood, which are incorporated, in

in ſome of the moſt digeſted and ripen'd *Serum* of the Blood, and by that means appear in the Form of a Mucilage.

That theſe Spirits are made up of the fineſt Sulphureous Particles and the moſt volatile Salts of the Blood, is apparently proved by our conſtant Diet; for we always perceive our ſelves moſt full of Spirit after Meat that abounds with Sulphur, volatile Salts and Oyls; whereas all Acids, Auſteres, &c. which thicken Oyl, and take of the Force of volatile Salt and Sulphur, depreſs our Spirits and keep them too low.

That theſe Spirits are full of ſulphureous oyly Matter, is farther manifeſt, by expoſing the Brains of any Animal to the

the Air; becauſe they preſently grow rancid and fœtid.

It appearing then, that the Animal Spirits are an oyly mucilaginous Subſtance, abounding with the moſt volatile Salts and Sulphurs of the Blood; and that they are in a continual Circulation from the Brain and ſpinal Marrow through the Branches of the Nerves; and that being forcibly laid down in the Glands, there meet with the Arterial Blood; I ſhall next endeavour to ſhew, how the Heat of the Blood is carried on and continued; which, I conceive, to be after this Manner.

Theſe

The Reaſon of the Heat of the Blood explained.

Theſe oyly Salino-Sulphureous Spirits, being violently driven through the Nerves, meet with the Arterial Blood in the Glandules; and theſe two Liquors being forcibly driven one againſt another, the Particles of them are intimately mixed together; by which means the Animal Spirits are, as if it were, ground and rubbed betwixt the fixed and more ſolid Particles of the Blood; whereby they are minutely diſſolv'd, and being put into a ſwift inteſtin Motion, they endavour powerfully to expand themſelves, and to fly away; but being held in, and reverberated, by thoſe groſſer Particles; their Mo-

Motion is by that means inverted, and that Force, which, if they had but Liberty, would be loſt in a further Expanſion, being inverted and driven forcibly upon the other Particles, they mutually increaſe and promote one anothers Motion; by which Motion the Blood, when it affects our Senſory, cauſes us to perceive Heat.

How it's Heat is promoted.

In carrying on of which, it is to be obſerv'd, that the Animal Spiritsbeing thus accidentally expanded, and put into Motion, by the groſſer Parts of theBlood, and being thus held in, and ſtruck back, by them; does not only by that Means fly back and increaſe each others Motion;

Motion; but alſo hurry the groſſer Particles of the Blood along with them, and ſo increaſe their Motion, and by ſtriking againſt them, and knoking them together, break them, as if it were into ſmaller Parts, and conſequently rarify and expand Them alſo.

The Heat of the Blood varies according to the different Quantities of them.

It is further to be obſerved, that as theſe Spirits are more or leſs in quantity, ſo (the groſs Parts of the Blood, grinding them together and putting them in Motion,) they more powerfully, or leſs vigorouſly expand, and moving accordingly, digeſt and rarify the Maſs of Blood to a higher or lower Degree; and conſequently,

ly, put the Parts of it into a ſtronger or weaker Motion.

We may further take Notice alſo, that the ſharper the Particles of the Blood are, ſo they corrode and grind the Spirits into Parts, with greater Violence, and conſequently ſharpen their Motion.

It varies alſo according to the ſharpneſs of thoſe Humors that put the Animal Spirits into Motion.

Again, when the Maſs of Blood is very full of, and plentifully abounds with, volatile Salts & Sulphur, the Particles of it, are with leſs difficulty put into Motion by the Spirits; and joyning with them,

The volatile Salts and Sulphurs in the Maſs of Blood make it more apt to be fermented.

them, encreaſe their Motion; and, on the contrary, when the Maſs of Blood is more dull and phlegmatic, it neither ſo powerfully grinds the Animal Spirits, nor is ſo eaſily put into Motion it ſelf.

Which is more or leſs promoted according to the different Degrees of the Activity of the Spirits.

Furthermore, The Animal Spirits do not only according to their different Quantities, differently exagitate the Maſs of Blood; but alſo, according to their different Degrees of Activity; whence the more volatile and ſtronger the Spirits are, the more conſpicuous are their Effects.

Laſtly,

Laſtly, we may take Notice, that neither the Animal Spirits, nor the Maſs of Blood, are altogether Active or Paſſive, in producing theſe Effects; but mutually both of them, and by Turns.

Neither the Animal Spirits nor Arterial Blood are wholly Active or Paſſive.

Having premiſed this ſhort Account of the Heat of the Blood, without any manner of Proof, to the end, that we might have a more clear and entire View how it was cauſed; without the Interruptions it would have made, to prove every Paragraph as I propoſed it; I ſhall now proceed to a Proof of what I have propoſed collectively, for the Material,

Formal and Efficient Cauſes of it.

And *Firſt*, That the Animal Spirits and Arterial Blood are both forcibly laid down in the Glandules; I have given ſufficient Reaſons to evince, in my Treatiſe of *Muſcular Motion*, and have given further Proof of it here.

That the Heat of the Blood proceeds from Fermentation proved.

To prove then, that the Heat of the Blood does proceed from that Fermentation, it being neceſſary to explain the mechanical Motion of the Parts of thoſe Liquors, that work mutually one upon another; I ſhall in the next Place ſhew, that the Heat of the Blood is cauſed by ſuch a me-

mechanical Motion of Parts, as I have before mentioned.

That the Animal Spirits then are forcibly driven againſt the Arterial Blood, is ſo ſelf evident, that it needs no Proof; and if ſo, it muſt needs follow that the Particles of the one will be intimately mixed with the other; and it is undeniably True, that the Animal Spirits will by that means, be ground and rubbed betwixt the Particles of the Blood, which are in Motion, and amongſt which, they are mixed; and the Animal Spirits, being of an oyly Salino-Sulphureous Nature will conſequently be expanded and rarified, and put by that means into a ſwifter degree of Motion, is evident; whether we conſ-

der the Effects, that ſolid or liquid Subſtances have on one another, when in Motion; for Amber, by a violent Attrition of it's Parts againſt a woollen Cloath, feels hot; the Sulphureous fat Effluviums being by that Attrition encreaſed, and cauſed to fly out in greater Quantities. It is evident alſo, by ſtriking of a piece of Flint againſt Steel, that the ſulphureous Particles of the Flint, being, as if it were diſyok'd from the Embraces of the more firm and ſolid Particles of the Stone, and being rubbed and ground betwixt them are put into a violent Motion; which cauſes them ſo much to rarify and expand, that whenever they affect our Senſory, they cauſe that Senſation

we

we call Heat; which is accordingly violent, as their degrees of Motion are more or leſs intenſe; and ſo Amber, by a mild Attrition is moderately warm, and by a violenter, more ſenſible.

That Heat proceeds from Attrition further proved.

Again, It is obſervable in the turning of any large and weighty Wheel, where the extraordinary Weight makes ſuch a forcible Preſſure of thoſe Parts that lie about the Axle-tree, that by ſtrong and frequent Attritions of the Parts together, the crude Sulphur, which is fettered up in the Subſtance of the Wood, is by degrees looſned and diſſolved, and being put into Motion is rarified and

expanded; which being ſtill ground betwixt the ſolider Parts of the Wood, it's Parts are yet put into ſo ſtrong a Motion, that they break and diſſolve that ſolid Subſtance, and by creating a Flame conſume and burn it.

In like manner, the Particles of Fire being applyed to Gunpowder, by diſſolving and grinding of it's Parts in Pieces, and putting them into a violent Motion, cauſe them to expand and explode.

Not only ſolid Bodies but alſo Liquids grow hot by an Attrition of their Particles.

But not only ſolid Bodies cauſe Heat, by grinding of volatile ſulphureous Particles betwixt them, and ſo by putting them into Motion; but alſo

alſo the Patticles of Liquids, by grinding one upon another, put themſelves into ſo violent a Motion, as not only to cauſe Heat; but ſometimes ſo high a degree of it, as actual Flame; as, when Spirit of Wine and Oyl of Turpentine are mixed together: And that Heat proceeds from an Attrition of ſulphureous Particles, and their violent Motion; I have not only brought Inſtances enough to make it appear, but have ſufficiently proved it before in my Anſwer to Dr. *Willis*'s Opinion.

And now, ſince not only Solid, but alſo Liquid, Bodies grow hot, by an Attrition of their more volatile and ſulphureous Particles, betwixt the more groſs ones, and ſince there

appears from what I have before ſaid, but one way, by which all Bodies grow hot; we muſt needs conclude, that the volatile ſalino-ſulphureous Particles of the Spirits grow hot, by being ground betwixt the groſſer Particles of Arterial Blood; and that thoſe, by putting the whole Maſs into a more violent Agitation, cauſe the Heat of the Blood.

But ſome will perhaps ſay, that in all thoſe Phænomena, I have mentioned, theſe groſſer Parts of Matter, which grind upon the ſulphureous Particles, are put into Motion by ſomething elſe: But they do not perceive, how the groſſer Parts of the Blood are put into Motion firſt.

To which I anſwer, that the Particles of the Maſs of Blood, are put into Motion by that force, which is always inſeparably joyn'd with Circulation; ſo that in a Man's Body, as there is a continual Circulation of Humours; ſo there is of Cauſes; for the Fermentation, in the muſculous Glands, is raiſed by the Maſs of Blood, grinding the Animal Spirits betwixt the Parts of it; in which Fermentation a ſubtile Liquor is prepared, which being forced into the Fibres of the Heart, cauſe it to contract; which Contraction forces the Blood, and conſequently the Nervous Juice, through their diſtinct Veſſels;

The Particles of each of theſe Humours are firſt put into Motion by Circulation.

Veſſels; and ſo cauſes them again to meet, and ferment a ſecond time, in the Glandules; and as Circulation is preſerved and carried on by the ſubtile Liquor, which is continually prepared in this Fermentation, ſo the Particles of the Blood are mixed with the Spirits, and preſerved in Motion by Circulation.

Having thus ſhew'd, that the Heat of the Blood may as probably proceed from Attrition, as Heat in any other Bodies; ſince Heat is nothing elſe, in reſpect of that which cauſes the Senſation, than a quick inteſtin Motion of Parts, and ſince thoſe can be put into Motion no other way but by Attrition; I ſhould in the next Place prove,

that

that the Particles of refined and rarified Matter always expand and endeavour to fly away, but, being reverberated by the Oppoſition of thoſe groſs ones, with which they ſwim, their Motion is inverted, and by that means much increaſed. But it is ſo evidently True, that it needs not; for we always obſerve, that where any two Bodies meet together, and ſtrike againſt one another, that which is leſs yields to that which is moſt ſolid, and makes the ſtrongeſt Oppoſition; this is manifeſt in Flame it ſelf, as alſo in the Expanſion of Gun-pow-

That the Particles of refined and rarified Matter, are by an Inverſion of their Motion put into a higher degree of it proved.

powder; for if a Gun be ſhot againſt a Wall, the Flame of the expanded Gun-powder ſtriking againſt it, preſently flyes back again, and, by mixing with that, which immediately follows it, encreaſeth the force of it; and for this Reaſon, a Gun which is charged with a greater weight of Shot, more forcibly recoils; the Powder not finding free Liberty to expand, but flying backward with a greater Force: It is alſo further evident, from the Reaſon which I have given, why Nitre is beneficial in continuing Flame, and making it more vigorous.

The

The groſs Parts of the Blood, having thus put the Animal Spirits into a ſwift Motion, and by inverting them in their Motion, having cauſed them to encreaſe one anothers Motion; the Spirits at laſt, ſet upon the Maſs of Blood, and by breaking and diſſolving the Particles of it, rarifie them and cauſe them to expand alſo; ſo the Rays of the Sun, being in a ſwift Motion, and gathered into a Point by a burning Glaſs, grow more vigorous, ſo as to diſſolve and burn even ſolid Bodies; and after the like manner Flame, by the force of it, ſubtilizeth and attenuates the Sulphureous Parts of it's Fuel, neither

How the Animal Spirits rarifie the Blood.

neither does it only rarifie and expand the Sulphureous Matter of it's Fuel, but alſo carries violently the Aſhes of the calcined Matter along with it, where it may be obſerved, that as the Particles of Animal Spirits are not in ſo ſtrong a Motion, as thoſe of Fire, ſo the Particles of the Blood are moved with a more eaſie force, then Aſhes which are far more Solid.

That the Animal Spirits according to to their different quantities differently exagitate the Maſs of Blood prov'd.

But for a further Proof, that the Maſs of Blood grows hot, in a Natural ſtate, by the Methods and Ways, which I have endeavoured to explain; I ſhall in the next place

place prove, that the Animal Spirits, being put into Motion, according to their different Quantities, differently expand themſelves, and exagitate the Maſs of Blood, and put it's Parts in a more violent or weaker Motion, and conſequently encreaſe or diminiſh the Heat of it.

By the obſervation of People of different Ages.

And this is eaſily manifeſt, if we do but obſerve, that young & healthful People, whoſe Nerves as well as the Fountains from whence they ſpring, are full of, and abound with, Spirits, are always of a more brisk and vigorous Heat then People of a declining Age, whoſe

whoſe Nerves are leſs plentifully ſtocked with them.

As alſo by different Conſtitutions.

But it is not only obſervable in People of different Ages, but alſo in different Conſtitutions, that as the *Pabulum* of the Animal Spirits is more plentiful and yields a more conſtant and large Supply; ſo the Heat of the Blood is more powerful and intenſe; as in cold and Phlegmatick Conſtitutions, where the Maſs of Blood abounds, with dull Phlegmatick Humours, or Acid and Auſtere Juices, of too cloſe and compact Texture, and a large Supply of Spirits is denyed; the Blood is not of ſo hot a Temper, as in Cholerick Conſtitutions; whence it evidently appears,

appears, that the Heat of the Blood depends on the Vigour of the Animal Spirits; for if when the Veſſels are filled with Spirits and plentifully ſupply the Glands, that Fermentation is raiſed higher, and by that means the Heat of the Blood is accordingly encreaſed, it is a moſt certain Concluſion, that the Heat of the Blood depends upon the Effects, that the Animal Spirits have in that Fermentation.

And the Practical Part of Phyſick.

Which is further confirmed, by the common and conſtant Practice of all Phyſitians; for when the Natural Heat, as ſome call it, is languid and weak, and almoſt extinguiſhed; they give ſuch Medicines,

dicines, as increaſe the Heat of the Blood, by renuing the Vigour of the Spirits; whence to People that are almoſt a dying, their Spirits being dulled or exhauſted, nothing is more uſual then to give them Spirits of Harts-horn or of Armonick-ſalt, or ſome other Saline or Sulphureous Spirits, which preſently joyning with thoſe in the Nerves, encreaſe the Fermentation in the Glands, and by that means put the Maſs of Blood into a more ſwift Exagitation; and by raiſing the Fermentation, not only renue Circulation, but the Heat of the Blood.

How Spirit of Harts-horn raiſes the Pulſe.

On

On the contrary, when the Animal Spirits are too high and volatile, or too much in Quantity, they raiſe this Fermentation ſo high, that the Blood is preſently put into a Preter-natural Heat; from whence proceeds that Preter-natural Heat in Fevers: And the way, that Phyſitians either do, or can take, in ſuch Caſes is, either to take down the Animal Spirits, by withdrawing Part of their *Pabulum*, and by Acids given internally, to harden the Texture of the Blood, and make it leſs ſubject to grow too Hot by Fermentation; or otherwiſe by

That the Spirits according to their different Degrees of Activity variouſly exagitate the Maſs of Blood.

by cooling and fixing thoſe predominant Spirits, and evacuating other acceſſory Cauſes, by proper Excretories and Emuctories of the Body.

Laſtly, That the more any rarified Sulphureous Body is expanded betwixt the more groſs and ſolid Parts of Matter, thoſe groſs ones are put into a ſtronger Motion, is evident from a Musket charged with Shot, which, with a ſmall quantity of expanded Matter, will ſcarce be moved; but by a greater quantity of exploded Matter, are put into ſo ſwift a Motion, that they fly forcibly a conſiderable way.

Having

Having thus far proved, what I propoſed, to be reaſonable and likely, and nothing but what is conſonant to the Practice of moſt Rational Phyſitians; I proceed to ſhew, that the ſharper the Particles of the Blood are, they corrode and grind the Spirits into ſmall and minute Particles with a great deal more Violence, and by that means cauſe them to expand more vigorouſly, and by putting them into a ſtrong Motion, cauſe a higher Degree of Heat.

The ſharper the Particles of Blood are the more they corrode the Spirits and put them into Motion.

This is ſufficiently proved by

The Reaſon of flushing heats in the Scurvy.

by the Preter-natural Effects, that Scorbutick Salts cauſe in ſome People; for when the Maſs of Blood is impregnated with Acid Acrid Humors, theſe, meeting with the Spirits, cauſe Preter natural flushing Heats; which appear in ſeveral Parts of the Body, and ſometimes in the whole; which are ſo violent, that thoſe, that are affected with them, complain; that they feel themſelves as Hot, as if they were in a Stew or a Bagnio.

That this Preter-natural Heat proceeds from Corroſive Salt Humours, fermenting with the Spirits, is very manifeſt; ſince theſe Symptoms are only cured,

red, by ſuch Medicines as correct the Acidity and Acrimony of the Blood, *viz.* When it moſt partakes of *Acrimony* by ſweet diaphoretick *Decoctions*, or ſome ſort of Acids, which dull and take off their corroding Edges, or when they are more Acid, by volatile Salts that carry them off by Sweat or Urine; or by Acid Abſorbers, which by correcting the Acidities of the Pancreatick Juice, leave the Ferment of the Liver more predominant; and the bitter Choler, being by that means bred a great deal more plentifully, digeſts and carries off thoſe crude Humors, which by the aforeſaid means being made thin enough, to go off by Urin and inſenſible Tranſpiration, are

diſperſed and carry'd off thoſe ways; and the Maſs of Blood, being cleanſed of thoſe ſharp Humors, is reduced to a healthful State.

Proved by comparing the Nature of the Medicines that oppoſe it and correct it.

If then by conſidering the Nature of thoſe Medicines, that correct vitious Humors, we may learn to know what is the Nature of thoſe Humors; we muſt conclude, that whatever is corrected by Medicines directly contrary to Acrimony, the nature of that Humor is Acrid; and when, by the Uſe of volatile Salts, the diſtempered Humors of our Bodies, are attenuated, and diſpoſed to Evacuation, and at the ſame time

time we know, that volatile Salts by volatizing and preparing the ſuperfluous fixed Acid Acrid Humors of the Maſs of Blood, diſpoſe them to be carried off, we have all the Reaſon imaginable to conclude, that when we find thoſe Medicines carry off ſuch Symptoms, that they are cauſed by ſuch Humors,

And that theſe flushing Heats in the Scurvey, proceed from Acrid Acid Humors is plain, becauſe all Salt Meat, that abounds with Acids; and all ſharp Acrid Bear, that hath an Acrid Fluid Salt predominant in it, as alſo Vinegar and ſuch like, make thoſe Symptoms more violent.

If then, both from the Method of Cure, and the Cauſe it ſelf augmented by ſuch Sorts of Juices, we gather they proceed from ſharp Acrid Acid Humors, we may be certain, that thoſe Symptoms are cauſed by ſuch Humors grinding and corroding the Animal Spirits, and that by putting them into a Preter-natural Motion, they are the Cauſes of ſuch Senſations.

And that thoſe Senſations only proceed from thence, we may eaſily conceive; for ſince, as long as thoſe Humors circulate with the Maſs of Blood, and forcibly meet with the Animal Spirits, they can only affect them, by moving amongſt them; they muſt needs put them

them into a more ſwift Motion, and an unuſual Expanſion, by corroding and grinding them more powerfully, betwixt their Particles, which is evident from the cauſe of thoſe fluſhing Heats I juſt now mentioned, and from the Reaſon I have before given of Heat.

But that the ſharper the Maſs of Blood is, the more the Animal Spirits are ground and expanded betwixt the Particles of it, is evident from Reaſon it ſelf; for it being proved before, that the Heat of the Blood proceeds from a ſwift inteſtin Motion of the Particles of the Blood and Spirits, cauſed by Attrition; nothing is more Reaſonable than that the more ſolid the Maſs of Blood is, the

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ſtronger the Attrition is, and conſequently the Motion of Particles, which upon our ſenſory cauſe heat, muſt be more violent; and as in ſtriking of a Flint with a peice of Steel, the more firm and hard the Steel is, the more powerfully it looſneth the Texture of the Flint, and ſtrongly expanding it's Sulphureous Particles, puts them into that Motion, which conſtitutes Flame; ſo by Parity of Reaſon, we may expect, that the Particles of Blood will cauſe the Sulphureous volatile Parts of the Spirits, to expand more powerfully, the more ſolid and compact they are.

And

And that the Texture and Conſtitution of Saline Humors, is more Solid, and their Parts more Corroding, than of a ſweet Balſamick Liquor, I think, none can deny, who compares Vinegar and Spirit of Vitriol with Tincture of Sulphur, and although in Fevers, where the Blood abounds with too much exalted Sulphur, Spirit of Vitriol and other Acids, cool the Blood, by fixing the Spirits, and Coagulating the Sulphur; yet when the Blood is impregnated with Scorbutick Salts, Acidity joyning with Acrimony, cauſes Heat, by corroding the Spirits, when they want a Mixture of crude Sulphur, to dull their Edges, of which it would be no difficulty

to convince, thoſe that are conſiderably troubled with ſcorbutic Symptoms.

That as the Blood is more or leſs Volatile, it's Parts are put more or leſs eaſily into Motion proved.

But *furthermore*, I ſhall prove that the Maſs of Blood, the more it abounds with volatile Salts and Sulphurs, is more eaſily put into a violent Heat; and that it's Particles being more eaſily put into Motion, readily joyn with the Animal Spirits, and encreaſe theirs; and that on the contrary, the more dull and phlegmatic any Body is, the leſs apt are it's Particles to be put in Motion.

And as it is commonly taken notice of, in all Bodies, ſo it is not leſs obſervable in the Maſs

Maſs of Blood; for we always find, that the leaſt quantity of any volatile Liquor inflames the Blood of thoſe, that are of a tender and open Conſtitution, much ſooner then phlegmatic and melancholly Peoples, and as the former is evident in thoſe that are ſubject to Fevers; ſo the latter is not leſs remarkable in thoſe of cold Conſtitutions; for to encreaſe the natural Heat of their Blood, when it is too much depreſſed, it is not only neceſſary to take away ſome of thoſe crude Humors, which ſtuff up the Veſſels, and too much depreſs the Spirits; but alſo, by volatile and ſpirituous Medicins, to encreaſe the Spirits; and at the

ſame time, to exalt and ſpiritualize the Blood, by abſorbing Acids, and exalting the volitile and ſubtile Parts, to render them predominant.

And that it is differently promoted according to their different Degrees of Activity of the Spirits.

Moreover, that the Animal Spirits do not only according to their different Quantities, and the different State of the Blood, variouſly exagitate and encreaſe the Heat of it; but alſo, according to their different Degrees of Activity and Strength is put beyond Diſpute by the different Effects that *Spirit* of *Wine*, or *Aqua-mirabilis*, hath upon us from *Sack* which any one that does but

but taſte muſt ſoon acknowledg.

How far the Blood and Spirits are Active or Paſſive.

It remains in the next Place, that I ſhould ſhew, how far the Animal Spirits are Active, and how far Paſſive, in cauſing theſe Effects, as well as the Blood, which evidently appears from what I have already ſaid: For when the Spirits and Blood are forcibly driven together, then they ſeem to be mutually Active and Paſſive, the Spirits being forced betwixt the Particles of the Blood, and *vice verſâ*; but the Animal Spirits being ground and rarified betwixt the Particles of the Blood, are ſo far Paſſive; but

but being by that means expanded, by a powerful expanſive and elaſtic Motion exagitate the Maſs of Blood, and by that means are active; ſo that throughout the whole Proceſs it appears, that neither of them ſingly are altogether Active or Paſſive, but both, mutually and by turns.

How the Heat of the Blood is continued.

From what I have ſaid it appearing, how the Heat of the Blood is cauſed; I ſhall in the next Place proceed to ſhew, how it is continued; which will be ſufficiently evident, if we do but conſider, that the Animal Humors are in a conſtant and con-

continual Circulation; for ſince all the Blood in a Man's Body, is allowed to circulate through the Heart, ſeveral times in an hour; and that the Blood from thence is continually forced and diſperſed through the Parts of the Body, and ſo great a Quantity of Blood is at one Pulſation, laid down in the whole Habit of the Body, and ferments at the ſame time, with the Animal Spirits; there muſt needs be raiſed in the Blood, a conſiderable Heat, or in other Words, the Parts of the Blood and Spirits muſt of neceſſity be put into ſo ſwift and intenſe a Degree of Motion, as to enable them to produce an extraordinary Heat, when they ſtrike upon our Senſory. The whole Maſs

Maſs then circulating thus, through the Extremities of the Veſſels, there is not only a great deal of Blood fermented, every Pulſation; but alſo by a continual Succeſſion of Pulſations, the Blood, being forced into a Fermentation, by the expanſive Motion of the Spirits, is by that Means preſerved in a conſtant and continual Heat.

Some Objections *conſidered and anſwered.*

But I know, here will ſome Difficulties offer themſelves, and perhaps ſome may doubt, whether the Blood only ferments in the Extremities of the Veſſels, and not in the Veſſels themſelves; and ſince it is hot in the Arteries, before it be laid down

down in the Glands, as well as in the Veins after Fermentation; they may think it reaſonable to conclude, that whereever it ferments, there it's Fermentation is cauſed; and becauſe there is a great deal of Blood betwixt their Extremities, and the larger Veſſels; they may think, that the Fermentation in the Extremities, cannot be the Cauſe of the Heat of the Blood in the larger Veſſels; it being an old Maxim, that, *tolle Cauſam tollitur Effectus*; which is as much as to ſay, the Cauſe immediateley goes before the Effect.

Another Doubt which perhaps may ariſe will be, that ſince I affirm, that there is ſuch a mutual Action and Paſſion in the

the Attrition of theſe Humors, in order to a Fermentation; whether Fermentation can be carried on, in ſuch a manner, in ſo ſhort a Time, as the quick Circulation, and conſequently Protruſion of the Blood from the Extremities of the Veſſels admits?

The firſt Obje-ction anſwered, viz. whether the Heat of the Blood be chiefly cauſed in the Extremities of the Veſſels.

As to the *Firſt*, To wit, whether the Fermentation of the Blood be cauſed in the Extremities of the Veſſels, or the large ones; I affirm, that it is chiefly and originally cauſed in the Extremities of the Veſſels, juſt where the Nerves and Arteries meet, and where their contents

are

are firſt mixed together; and that the Fermentation in the larger Veſſels is but a Continuation of the Effects of the ſame Original Cauſe; and as when Water is heated over a Fire, that Part of the Water, which is at the top of the Veſſel that contains it, is as truly ſaid to receive it's Heat from the Fire, as that in the Bottom, ſo that Blood which is in the Body of the *Vena Cava* is as really put into a Fermentation, by a Mixture of Spirits, as that in the Extremities; for the Animal Spirits, being mixed with the Arterial Blood in the Glands, and ground betwixt their Particles, and being by that means put into an elaſtick and expanſive Motion, they

they powerfully ferment and exagitate the whole Mass. This Blood then, so fermented, is thrust out of the Glands, by a Succession of Matter forced in the next Pulsation, and so forwards, by the next, successively, till it be driven into the *Vena Cava*.

Now as soon as it is thrust out of the Glands, those Spirits which did so powerfully expand before, and the remaining Part of them, which are not mixed with that subtile Liquor, that circulates through the Fibres; being yet further corroded and exagitated by Pulsation, still continue to expand themselves, and by that means, keep the Blood in a continual Heat.

The

And the Animal Spirits being yet more expanded, do not only continue, but in a great Meaſure encreaſe the Heat of it.

The Reaſon why the Heat of the Blood in time decays.

But theſe Spirits, being frequently oppoſed in their Expanſion, by ſtriking againſt the Blood, looſe in a ſhort time a great deal of their Vigor, the Particles that before grund the Animal Spirits betwixt them, obſtructing their Motion; and the Animal Spirits, not being able any longer to keep them in a juſt Motion, ſufficient to continue the Heat, which is Natural to human Blood; they are, as if it were, linked and fettered up, betwixt thoſe groſſer

groſſer Parts, & are incorporated into one Subſtance with them, which is the Reaſon, that the Blood by frequent Circulations, is ripened and digeſted; and for this Reaſon the fleſh of a Hare grows tenderer, by being courſed along time.

The Blood, being thus impregnated with Animal Spirits, and by that means wanting Spirits in a free and ſtrong Motion, would by degrees grow cold; but the Intervals of time, while the Blood moves from the Extremities of the Veſſels to the Heart, and from the Heart to the Extremities of the Veſſels again, being very ſhort; before there can be any ſenſible or conſiderable Decay of it, the Blood is anew fermented in the Glands;

Glands; and ſo by a continual Circulation, the Heat of the Blood is preſerved; and becauſe by this time the Animal Spirits mixed in the firſt Fermentation with the Blood, are almoſt ſpent, being incorporated with it; and becauſe Part of it is continually ſeparated in the Brain, it meets a ſecond time with new Supplies, and alſo by repeated Fermentations is more impregnated with Spirits as well as digeſted and ripen'd to a higher Degree of Maturity.

Thus I have given an Account, how the Heat of the Blood is carried on in the Veſſels, that it might more clearly appear, how the Original

nal Cauſe of Heat is principally in the Glands.

And that Reaſon proved.

That the Animal Spirits are put into an elaſtick Motion in the Glands, I have before proved, by the groſſer Particles of the Blood; and that the Blood, ſo fermented, is ſucceſſively caſt out into the Veins, is plain enough, to any one that does but underſtand Circulation; to prove then, that the Blood, being thruſt out of the Glands, does by a further Expanſion of thoſe *Spirits*, for a while increaſe the Fermentation; and that, when the Vigour of the Spirits is ſpent, it will gradually decay; we need but take Notice, how Fermentation is begun

begun and carried on in other Liquors; for when oyl of Vitriol and Spirit of Armoniac Salt are mix'd together, the Parts of each being in ſome meaſure mixed, and put into Motion, by dropping the one into the other, they preſently begin to ferment; which fermentation is gradually exalted, till by a frequent Colliſion and Attrition, the moſt Fermentative Parts fly away, or their Vigour is loſt; and then Fermentation gradually decreaſeth; and in like manner, all other Liquors, that for a time ferment with a ſenſible Heat.

But if poſſible, it will further appear, that the Original & Principal Cauſe of Fermentation is in the Glands, if we do but conſider,

ſider, how Fermentation is carried on in a dying Body.

How Fermentation is carried on in a dying Body, and the Reaſon why it ceaſeth when it is quite dead.

For in a Body that is about to die, the Vigour as well as Quantity of Animal Spirits, being diminiſhed, and thoſe too, being leſs vigorouſly grund, betwixt the Parts of the Arterial Blood, expand ſo weakly, that they ſcarce agitate the Maſs of Blood, ſufficiently to preſerve it's Heat, but as ſoon as the Blood and Spirits ceaſe to circulate, the Heat of the Blood preſently grows milder, till at laſt it is quite extinguiſhed.

Now

Now, if when the Fermentation is weak, the Heat of the Blood is more remiſs and depreſſed; and when Circulation is ſtoped, it conſequently ceaſeth; it muſt needs follow, that the Animal Spirits are the Cauſe of that Fermentation; and that it is promoted by driving thoſe two Liquors forcibly together; and that the Fermentation is chiefly cauſed in the Glands, is plain, becauſe when the Spirits and Blood ceaſe to be driven together, and there fermented, the Heat of the Blood decreaſeth; and that it is not in the Veſſels is evident, becauſe after Circulation is ſtoped, it preſently declines, whereas if it were cauſed in the Veſſels, it would continue after Death as

well as before; ſince, it then hath the ſame Matter, though it wants Circulation and a forcible Mixture; and what I have ſhewed to be the Conſequences of it.

Another Argument to prove, that the Heat of the Blood depends on, and is cauſed by, Attrition.

I ſhall only bring one Argument more to prove, that the Heat of the Blood depends upon the Attrition and Fermentation in the Glandules; which may be inferr'd from this common Obſervation, that the Heat of the Blood is encreaſed by all violent Motion: For upon all violent Motion, a larger Quantity of Animal Spirits, being ſent to the Parts to be moved, in

in order to prepare a greater Quantity of ſubtile Liquor, to diſtend and dilate the Fibres; the Fermentation is not only raiſed higher in the Glandules, but the Motion of the Heart, being thus accidentally increaſed, quickens the Circulation of the Blood ſo much, that before the vigorous Motion of it's Parts, which was raiſed in the precedent Fermentation is ſpent; it is again renued.

But the Circulation of the Blood is not only quickened by the Contractions of the Heart; but alſo by the frequently repeated Contractions of the Muſcles: For the Heart contracting ſends it out into the muſculous Parts; and again, thoſe Muſcles drive it ſooner

and more forcibly back upon the Heart; from whence it appears, that both the Heat of the Blood is encreaſed, by being often fermented in thoſe Glandules, and conſequently, that it depends on the Mixture and Fermentation of the Animal Spirits, and Arterial Blood.

Fermentation & Circulation mutually depend on one another.

From hence it is manifeſt, how far Circulation is beneficial, in carrying on the Heat of the Blood; and if we conſider the Reaſon, which I have given of Muſcular Motion; we ſhall ſee, that as Fermentation depends on Muſcular Motion, ſo Muſcular Motion depends on Fermentation; ſo that, as I ſaid before, there

is

is a continual Chain and Circulation of Cauſes as well as Humors in a Man's Body.

To proceed therefore to the ſecond *Objection*, I ſuppoſed ſome might raiſe, *viz.* Whether this Fermentation can be carried on, in ſo ſhort a time as a continual and quick Circulation will admit: This does not only appear Poſſible from evident Matter of Fact; but alſo if we conſider, that in much leſs Time than what is allowed for Fermentation in the Glandules, if a Spark of Fire be put to Gun-powder, it immediately puts it's Parts into an Exploſion; and that the Blood

The ſecond Objection anſwered, viz. That Fermentation may be performed in ſo ſhort a time as the Circulation of the Blood admits.

not only ferments in ſo ſhort a time, but that it may prepare that ſubtile Matter, which circulates through the Muſcular Fibres, we may, with a great deal of Reaſon believe, if we do but take notice; that warm Milk, if it be but forcibly milked into Vinegar, it preſently is ſeparated into two Parts, *viz.* Curd and Whey. If then by mixing theſe two Liquors, they cauſe ſo great a Change on one another; I cannot conceive any Reaſon, why Part of the Animal Spirits, fermenting with the Blood, may not as ſoon be mixed with ſome Part of the rarified *Succus Nutritius*, and forced forward into the Fibres.

But

But from what I have ſaid, it appearing, that the Heat of the Blood is cauſed in the Glandules by Fermentation; and how it is continued in the Muſculous Parts; I ſhall in the next Place conſider, in what Parts it is moſt vigorouſly fermented; which will appear only by conſidering where the Spirits are moſt plentifully laid down; for if Fermentation depends on, and is chiefly cauſed by, the Animal Spirits, as I have ſhewn; then it muſt needs follow, that the Heat of the Blood is moſt promoted in thoſe Parts, where Animal Spirits are moſt predominant

The Blood is more powerfully fermented in the ſubſtance of the Heart than in any proportionable Part of the Body beſides.

minant. And having proved that in order to prepare that ſubtile Liquor, which cauſes Contractions of the Muſcles, a greater Quantity of Animal Spirits is ſent there, it will follow, that the Blood grows hotteſt, being moſt vigorouſly fermented in thoſe Parts that are in Motion; and then it will follow, that the Heart being a Part in conſtant Motion, and that Motion proceeding from a ſucceſſive Supply of Spirits, the Blood muſt needs acquire the moſt conſiderable Degree of Heat, in the Subſtance of it.

But although I ſay that the Blood, for theſe Reaſons, acquires a greater Heat in the Heart, then in any other Part; I would not be thought to mean,

mean, that it grows hot ſo in the Ventricles of the Heart: For the Uſe of the Heart, being only to force the Blood out of it, and by dilating to receive it in again, for another Expulſion, and ſo to keep it in Circulation, it can get no great Heat there; ſince it wants Spirits to ferment with it; but I only mean, that conſidering the Subſtance and Dimenſions of the Muſcular Part of the Heart, and that ſmall Portion of Blood contained in the Arteries diſperſed through it, that that Blood acquires a greater Heat than that Quantity of Blood does in another Part, that is not in Motion.

Fermentation is not only promoted in the Muſcular Parts, but alſo in the internal Bowels.

But there being, beſides Muſcular Parts, many conſiderable Internal Parts, in a Man's Body, in which a great Number of Blood Veſſels are diſtributed, it perhaps will be asked, whether Fermentation be carried on in theſe too? To which I anſwer, that Animal Spirits and Arterial Blood, being either mediately or immediately, laid down in them all, there muſt needs be a Fermentation; which being proved, upon ſuch Premiſes, by what I have already ſaid, there is no need I ſhould repeat it again.

But ſince Anatomiſts have not as yet diſcovered Nerves to be diſtributed through the Liver,

Liver, although Blood be communicated to it, by the *Vena Porta*, which ſupplies the Office of an Artery to the Liver, it perhaps may be doubted, whether Fermentation is carried on after the ſame Manner there; and conſequently, whether the Office of the Liver be performed by Fermentation, or not; that it is, I ſhall ſhew hereafter, and alſo how the Glands in that Part, are ſupply'd with Spirits.

From what I have hitherto ſaid, it appears, what are neceſſary to continue the Heat of the Blood; and alſo, what is the Cauſe of it.

For

For *Firſt*, It is neceſſary that the Animal Spirits and Blood ſhould be in a continual Circulation, that being forcibly driven together, their Particles might be intimately mixed one with another. And;

Three things requiſite to continue the Heat of the Blood.

Secondly, That the Animal Spirits ſhould be grund betwixt the Parts of the Maſs of Blood, that they may be thereby rarified and expanded, and their Particles put into a ſwift Motion. And,

Thirdly, It is requiſite, that the Animal Spirits, ſhould be of an oyly Sulphureous volatile Temper; that being more eaſily rarified and expanded, they may

may be presently put into Motion, and cause the whole Mass to ferment.

Having then explained the Heat of the Blood, and proved it agreeable to these Circumstances; I am for the Reasons, before mentioned, perswaded to believe, that the Heat of the Blood thus proceeds from Fermentation.

OF

USE OF THE LUNGS

OF THE USE OF THE LUNGS.

FOR as much as appears from the Books of ſeveral Learned Men; the Uſe of the Lungs hath not been hitherto indiſputable, no more than the Uſe of other Parts: For as there are ſeveral Opinions concerning others,

others, ſo there are no leſs Diſputes about this; whilſt ſome would have it to be, only a ſort of Fan to cool and air the Blood: And others, that it was deſigned to kindle and put the Blood into a Flame, by continually ſupplying it with Nitre.

Whether of theſe is moſt probable, may eaſily be gathered, by conſidering the Effects that Air hath upon us: For ſince the Air is continually drawn in, and thruſt out again, in Reſpiration, any one that does but know, what Effects it hath upon himſelf, cannot be ignorant of the Uſe of the Lungs, in reſpect of the Heat of the Blood, evidently finding himſelf cooled by it; and

if

if any one, that, by daily Experience, finds that it cools him, can conclude thence, that it kindles and promotes the Heat of the Blood, he may be pleaſed with his Notion, but no Body elſe will with ſuch as contradict ſelf-evident Truth.

But that it may appear, how far the Lungs may be ſaid to be a Fan or *Ventilabrum* to the Blood; and whether the Air promotes the Heat of it or not; I ſhall take this Method; *Firſt*, conſider the Uſe of the Lungs with reſpect to the Rational Soul; and *Secondly*, with reſpect to the Body.

The

The Uſe of the Lungs in Reſpect of the Soul.

The Uſe of the Lungs, with a more immediate Reſpect to the Soul, appears to be nothing elſe, but as a large capacious Veſſel, endued with a Cavity, to contain a great Quantity of Air: ſo that it performs the ſame Office in the Body, as a Pair of Bellows to Organs: For as in Organs, the Bellows ſupply Pipes of different ſizes with Air, and that being driven through them, produces different Sounds; ſo the Lungs dilated and extended by the Motion of the *Thorax*, and being full of Air, contract; and accordingly as the *Pharinx* and it's Parts are differently modulated; ſo the Air

Air forcibly driven through them, cauſes different Voices.

In which Action, the Lungs ſeem chiefly to be an Organ made, on purpoſe, to be ſerviceable to the rational Soul, to expreſs all it's Conceptions and Reaſons; and to form Voices or Articulate Sounds, to ſignifie thoſe Notions contained in, and apprehended by, it; that thoſe Things, which muſt otherwiſe remain in ſilence, might be communicated, to promote a mutual Commerce and Converſation amongſt Men.

Is to expreſs all it's Conceptions and Reaſoning.

But here ſome may ask, if it be chiefly deſigned to form articulate Sounds, as it really ſeems to be, why do we take our

our Breath continually? Or why are our Spirits conſtantly conſumed, by keeping the Part in a perpetual Motion? Since ſometimes we uſe it very little for a long time, to expreſs any Thing by; one half of our Lives, and the larger too, being paſſed away in Silence.

Why the Lungs ought to be in a continual Motion is becauſe.

To which it may be anſwered, that it is neceſſary, the Lungs ſhould be in a conſtant, and continual Motion, that they might be kept in readineſs, to expreſs what and whenever, we have a Mind.

Another

Another Reaſon is, that ſince the Cavities of the Lungs, are conſtantly ſupplyed, with a ſerous *Lympha*, to moiſten their Coats, and to moderate the Acrimony of the Air, it is neceſſary there ſhould be a conſtant and continual Reſpiration, to carry that ſerous *Lympha* off; which would otherwiſe ſtuff up the Bladders of the Lungs, that they would be incapable of receiving Air; but every Inſpiration, that ſuperfluous Moiſture being mixed and incorporated with the Air, is by every Expiration carried off; which prevents thoſe ill Conſequences, which would otherwiſe follow.

It carries off that Superfluous Moiſture that ſupplies them.

Ano-

And that their voluntary Motion might leſs Preternaturally affect our Bodies.

Another Reaſon why the Lungs ought to be always in Motion, is, leaſt they ſhould Preter-naturally affect and diſturb the Conſtitution of our Bodies, when put in Motion, as we have a mind to expreſs our ſelves; for if the Lungs were at other times quiet and ſtill, our Bodies would be put into ſuch Diſorder, by violent and ſudden Motions, that we ſhould be as unfit to diſcourſe of any thing, as one that's in a Fit of the *Epilepſie*; but our Bodies being accuſtomed to it, and it being made agreeable and conſiſtent with Circulation of the Blood; becomes leſs troubleſome,

ſome, when we have occaſion for Extraordinary Reſpirations.

For theſe Reaſons it is plain, why the Lungs ought to be in a continual Reciprocal Motion, the firſt of which is ſelf-evident and needs no further Proof; and the ſecond is ſufficiently evinced by the Conſequences, that follow, when this *Lympha* is not evacuated.

What Effects it cauſes when too thick, and alſo why thick foggy Air is troubleſom to ſome People.

When it is too thick, or too much in Quantity; or on the other ſide, the Air, which we breath is too thick and moiſt; and it is not duly carried off; there follow Obſtructions of the *Ducts* of the *Trachea* from whence proceed Symptoms

ptoms of an *Aſthma*, *Orthopnœa* and *Duſpnœa*, ſome ſorts of Phthiſicks, and a great many more dangerous Symptoms.

For when it is too thick, it ſticks faſt to the Coats of the Lungs, and not being eaſily enough mixed and incorporated with the Air, the Quantity of it encreaſes; till it ſtuffs up the Cavity of the Lungs; and when it is too much in Quantity, though it be thin enough; yet the Air being not able to carry it off faſt enough, it runs down the ſides of thoſe tender Veſſels, and by a gentle Irritation, raiſes a tickling Cough: *Laſtly*, when the Humor, that moiſtens the

Lungs

Lungs, is almoſt Natural as to Quality and Quantity; yet if the Air be thick and moiſt, it, being ſo much impregnated with it's own Moiſture, is incapable of carrying off the Moiſture, ſupplyed by the *Serum* of the Blood; whence People that are inclined to Obſtructions of their Lungs, in foggy and moiſt Air, find them more oppreſſed; that Moiſture which ought to be carried off, being left behind.

The Uſe of the Lungs in reſpect of the Body.

But if we conſider further the Uſe of the Lungs, with reſpect to the Body; we ſhall find other Reaſons, not only why it ſhould be in a conſtant Motion; but

alſo, we may underſtand, why we cannot live without a continual and free Circulation.

Seems to be to perform the Office of another Heart.

For in reſpect of the Body, the Lungs ſeem in ſome Meaſure to perform the Office of another Heart; and as the left Ventricle of the Heart contracting, ſends out the Blood into all the Parts of the Body, by the Ramifications of the Sanguiferous Veſſels, ſo the Lungs contracting, force the Blood, contained in the Sanguiferous Veſſels, which are diſtributed through their Lobes, into the left Ventricle of the Heart; and the left Ventricle being by that means more vigorouſly

gorouſly dilated, and more plentifully filled with Blood; a larger Quantity of it is forced out into the *Aorta*; and conſequently the Blood in the Branches of the *Aorta* is more copiouſly preſſed by ſubſequent Matter into the Roots of the *Vena Cava*, and ſo forwards, into the right Ventricle of the Heart; ſo that by the help of the Lungs, the Dilation of the left Ventricle of the Heart is immediately, and the Dilation of the right mediately promoted.

That the Lungs thus promote the Dilation of the Ventricles of the Heart, it is very reaſonable to believe, not only becauſe it is ſelf-evident, but becauſe, otherwiſe it will be very hard to conceive,

ſince the Motion of the Heart is only Contraction, and the Dilation of it's Ventricles only a Ceſſation from that Motion, how the Blood is forced into them with Vigour enough to diſtend their Cavities.

For there is ſo little Reaſon to expect, that they ſhould dilate of their own Accord; that we ſhould rather believe, they would be continually contracted, ſince all the Weight of Blood contained in the whole Sanguiferous Veſſels of the Lungs, could not poſſibly dilate them without ſome other force to help it, for the Subſtance of the Heart being contracted, and the Cavity of the left Ventricle ſo con-

conſiderably diminiſhed, ſo ſmall a Portion of Blood as hath Liberty to preſs againſt it's Orifice would make but a weak Preſſure and much too ſmall to dilate the Ventricle in ſo little time as intervenes the ſucceſſive Contraction, beſides the Heart having no Tendency at all to dilate it ſelf, ſince that would make it unapt to yield to Contractions, we muſt ſuppoſe, that a Part of ſuch Subſtance cannot eaſily be dilated but would require ſome Force greater then can be ſupplyed by an inconſiderable Preſſure of Blood faintly intruded by almoſt nothing at all.

But the Lungs being almoſt in a continual Contraction, in reſpect of the Sanguiferous

Veſſels, and conſequently ſqueezing out the Blood contained in them, help to dilate and extend the Left Cavity of the Heart, and conſequently the Right.

By helping the Blood to force violently enough into the Cavities to diſtend them againſt the next Contraction.

That the Dilation of the Ventricles of the Heart is only a Reſolution or Ceſſation from Contraction, is allowed and agreed upon; to prove then, that the *Venal* Blood cannot return with Force ſufficient to dilate the Right Ventricle of the Heart; nor is ſufficiently able duly to extend the Left, in order to the next Contraction, by that force it received from, and was put into,

to, by the former Contraction, but is aſſiſted by the Lungs, we may eaſily perceive: For not only the Blood in it's Veſſels, but even any Liquor, being forced through Pipes, whoſe Cavities encreaſe the further they run from their narrow and ſmall Original, always moves with leſs force the farther it goes: So that although in every *Syſtole*, the Blood ſhould be forced forwards from the left Ventricle, by a ſucceſſive Preſſure of ſubſequent Matter; and the Motion ſhould be ſtrong enough to make it circulate briskly through the narrow and capillary Twigs of the Arteries; yet when it

came into the Veins, it would move much more ſlow, and by that time it came to the Heart again, would want Force ſufficient to dilate the right Ventricle, and the right Ventricle being not duly dilated, ſo little Blood would be ſqueezed into the Lungs, that the Left would want a Supply of Blood to dilate it, and conſequently the Preſſure of Blood through the *Aorta* and *Vena Cava* would be ſo weak, that the next Dilation of the Right Ventricle would be weaker than the former, and ſo Circulation would gradually decreaſe.

But that weak Motion of the Blood into the Right Ventricle, being encreaſed by the

the Force of ſubſequent Matter from the Left, the Motion of the Blood into the Lungs is conſequently more plentiful, and as it paſſes through them is violently forced into the Left and ſo on; and by that means, as I ſaid before, the Lungs diſtend the Left immediately and conſequently the Right mediately.

That the Motion of the Blood is thus weakned by ſo long a Courſe in the Veins is further evinced; if a Vein and Artery be open'd at once; for the Blood runs out of the Artery much more forcibly; and indeed, it would be reaſonable to think it ſo, though it were not manifeſt by ſo plain an Experiment; for if Water in a

Ciſtern be put into a violent Motion at one end, the further it runs along, the leſs violent is the Force of it.

How ſtopping the Breath of an Animal kills it.

And it is further evident, that the Motion of the Lungs does aſſiſt the Dilation of the Heart; as I have ſhewed by ſtopping the Breath of any Animal, which for want of free Circulation preſently dies, and not becauſe the Flame of the Blood is by that means extinguiſhed; for as long as the Lungs duly perform Reſpiration, and the Heart violently contracts, and drives the Blood contained in it's Ventricles forcibly out, that Motion of the Blood being by a continued waving Preſ-

ſure

ſure decreaſed, is enabled by the Aſſiſtance of the Motion of the Lungs, to dilate the Ventricles of the Heart, with a ſufficient Quantity of Blood, to be forced out the next Contraction; but as ſoon as the Lungs ceaſe to aſſiſt the languid Motion of the Blood in dilating the Ventricles, it is not only leſs plentifully forced ſucceſſively thus into the Ventricles of the Heart, but by a weaker Preſſure of the Contents of them thruſt out, each ſucceeding Pulſation; the Arterial Blood is leſs plentifully driven forwards; ſo that the whole Maſs circulates ſlower by degrees, and alſo the Animal Spirits, being driven leſs violently into the Muſcles (that Supply of

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Spirits

Spirits ſeparated in the cortical Part of the Brain, being not ſo powerfully thurſt after by an equal Succeſſion of Matter) the Fermentation in the Glands is weaker, and conſequently the following Contractions gradually decline both in Number and Vigour, till at the laſt they ceaſe. But if before the Circulation of the Blood be quite ſtopped, that Animal be again permitted to breath; the contractive Force of the Lungs drive Blood more forcibly into the left Cavity of the Heart; ſo that the next Pulſation a greater Quantity of Blood is forced into the Arteries, which makes a more con-

Why by permitting it to breath again the Circulation of the Blood is renued.

conſiderable Protruſion of Blood into the Muſcular Glands, and alſo of Spirits through the Nerves; by which means, the *Thorax* contracting more violently, forces the Blood in greater Quantities into the left Ventricle of the Heart; and the Motion of the Heart at the ſame time increaſing, raiſes Circulation to it's natural Force, by ſqueezing Blood forwards into the Right and ſo ſucceſſively.

From hence it appears, that the Blood is forced into the Ventricles of the Heart by the help of the Lungs; for if, when the Motion of the Lungs is obſtructed, the *Syſtole* and *Diaſtole* of the Heart ceaſeth in a ſhort time; it muſt needs follow, that it is in ſome mea-

meaſure preſerved in that Motion by them, and it is further proved, becauſe the Motion of the Heart, does not only ſooner ſtop, when Reſpiration ceaſes; but alſo, becauſe it is increaſed by a renued Reſpiration; and any one that would be further ſatisfied of the Truth of it, let him hold his Breath a conſiderable time, and he will find his Pulſe gradually decay, which is again renued by reiterated Breathing.

How the Motion of the Heart is promoted in an Infant unborn.

But though from hence it may appear, that the Motion of the Heart is promoted by the Aſſiſtance of the Lungs; yet it perhaps may be a Queſtion, how this Defect is ſupply'd in un-

unborn Infants; and how their Blood circulates, ſince then their Lungs do not perform the Office of Reſpiration.

To which I anſwer, that in an Infant before Birth, the *Placenta* ſupplys that Defect; for that additional Force which the Infants Blood receives, from the Motion of Nouriſhment, violently forced into the Umbilical Veſſels, by the Pulſation of thoſe Arteries, that ſeparate it from the Mother's Blood in the Womb, do prove equivalent, and ſupply the Office of the other; but as ſoon as the Circulation of the Blood ceaſes to be promoted by a Separation and Protruſion of that Juice, it immediately, if unborn, dies; and after it is born hath

hath a continual Neceſſity of Breathing, as long as it lives.

Where it is to be noted, that as in one that breaths, the Lungs more immediately aſſiſt the left Ventricle, ſo in one unborn, the *Placenta* more immediately promotes the Dilation of the right.

Now although it from hence appears, that the Motion of the Heart is promoted, by the reciprocal Motion of the Lungs, yet it does not wholly depend upon it, for if it did, the Motion of the Heart would as ſuddenly ſtop, as that of the Lungs; but ſince it does but partly depend upon it, Circulation declines by degrees upon the ſtopping of it.

But

But that it may be better underſtood, how the Lungs, promote Circulation, I ſhall next ſhew, that the ſanguiferous Veſſels in the Lungs, are not only contracted by the Contraction of the *Thorax*; but alſo in every Inſpiration.

And ſince it is known, that the Bladders of the Lungs are encompaſſed about with the ſmall Twigs and minute Ramifications of ſanguiferous Veſſels; every *Syſtole* of the right Ventricle of the Heart, theſe muſt needs be filled and diſtended with Blood; and if ſo, conſequently that Blood muſt needs be forced by the Contraction of the *Thorax*, through the *Vena Arteriosa* with a conſiderable Force; and ſo be driven

ven into the left Ventricle of the Heart with more eaſe, where we may by the way take Notice, that the Blood in the *Arteria Venoſa* from the Orifice of the right Ventricle, is not only by that means thruſt into the minute Veſſels of the Lungs more eaſily, but alſo the Blood, that is to be forced forwards by the next Pulſation is more readily received by the *Vena Arteriоſa*, and the Ventricle more eaſily contracting (when the Veſſels of the Lungs are thus emptied by a Contraction of the *Thorax* than if they were diſtended) that ſubſequent Matter in the depending Parts is received and driven after it with leſs difficulty, the reſiſtance that diſtended Veſſels would

would make to the Egreſs of it, being thus prevented by the help of the Lungs.

That the Blood is thus forced out of the Lungs into the Ventricle of the Heart, is not only evident from Reaſon, but alſo Experience; for in violent Coughing, where the Lungs are almoſt in a continual Contraction, the Blood is more violently driven into the Habit of the Body; that it is forced into the Face viſibly appears; and that it alſo flows into the Habit of the Body is evident, in People that are let Blood, which by coughing much, is plentifully forced out of the Orifice; and that the Contraction of the Lungs in coughing can no otherwiſe force the

Blood

Blood into the Habit of the Body, but through the left Ventricle is very plain, and *Laſtly*, that not only the left Ventricle is by that means further dilated, but conſequently the right, by the Aſſiſtance of the Lungs is manifeſt, becauſe Circulation is preſently quickned by coughing; ſo that this one *Phænomenon* proves all that I have aſſerted concerning the Uſe of the Lungs with reſpect to the Heart.

But it may here alſo be queſtioned; how the Lungs ſupply the Heart in Inſpiration, when the Cavities of the Lungs are dilated?

To which I anſwer, that though the Cavities of the Lungs are dilated in Inſpiration;

on; yet the Bladders which are ſwelled and dilated with Air, even then, make a moderate Preſſure upon, and conſequently a Contraction of, the Blood Veſſels, that are about them.

But though there were no ſuch Contraction upon Inſpiration, yet the Dilation of the *Thorax* is not ſo long continued; but that the Lungs renue the vigorous Contractions of the Heart, before they are ſenſibly decreaſed; as I have before explained it.

From what I have ſaid, of the Uſe of the Lungs with reſpect to the Rational Soul, as well as the Mo-

The Office of the Lungs is partly voluntary, partly involuntary.

tion

tion of the Heart, it appears, that the Lungs perform a Sort of a mixed Action; partly voluntary and partly involuntary; with reſpect to the Body, it is involuntary, being carry'd on whether we will or not, and when we are able to take no notice of it; and with reſpect to the Soul, voluntary, it being in our Power to quicken or remit the Motion of them, differently to modulate our Voices, as occaſion and neceſſity require, or our own Will inclines us.

But beſides theſe extraordinary Offices it performs in promoting both a Circulation of Humors and of Diſcourſe; ſince there is ſuch a great Quantity of Air drawn in by every Inſpira-

ſpiration, it muſt needs produce ſome Effects in the Maſs of Blood; and thoſe Humors that circulate along with it; and ſince it is ſo minutely mixed with it, by the ſmall and circular Windings of the Blood Veſſels about the Bladders of the *Trachea*; the Blood muſt needs be ſufficiently impregnated with Nitrous Particles.

But it being a Queſtion, how the Nitre of the Air comes to be mixed with the Blood, and whether the Air it ſelf be mixed with it alſo, before I proceed to ſhew how the Maſs of Blood is affected by it, I ſhall endeavour to ſolve theſe two Queſtions. And,

Firſt, That the Air it ſelf is no otherwiſe mixed with the Maſs

Maſs of Blood, but as I have ſhew'd, *viz.* by the Mediation of the diſtinct Veſſels in which each run is plain, becauſe we don't perceive the Effects of it in that Maſs, and alſo we may probably gueſs ſo, becauſe Air would hinder Circulation and much diſturb it: Air being always unapt to mix with Liquids and to fly from their Embraces, there being therefore theſe Reaſons, why it ought not to be mixed with the Blood, and none that it ſhou'd, nor any Sign of it being ſo, we have Reaſon to conclude that it is not. But,

Secondly, That thoſe Nitrous Particles which ſwim in the Air, are mixed with it, we ſee manifeſtly by the Effects, which

are

are cauſed by them, there being the ſame Alterations in ſome Meaſure made in the Blood as it paſſes through th Lungs, as when expoſed to the open Air.

But, the Queſtion then will be, how the Nitre of the Air is mixed with the Maſs of Blood, and by what means. To which it may be anſwered, that if we conſider what fine and ſubtile Bodies, thoſe Particles of Nitre are, which we draw in by Inſpiration; and through what minute and ſmall Pores, they are capable of paſſing, ſo that they penetrate the moſt ſolid Bodies in Nature; well may we ſuppoſe that they can find Pores fine enough to paſs through the Coats of the Veſſels.

That they paſs through the moſt compact and ſolid Bodies; Bodies that are much more cloſe and leſs Porous, than the Veſſels of the Lungs are, is certain; for otherwiſe, hot Water contained in a brazen Veſſel would never grow cold, and that the ſubſtance of Braſs is leſs porous than the Subſtance of the Lungs, no thing is leſs dubious.

Moreover, ſince that the Nitrous Particles of the Air are conveighed into the Blood, is ſo plain from the Effects that are there cauſed by them, they muſt needs be conveighed through thoſe Pores, there being no other ways at all for them to paſs by. But,

Another Queſtion which may per-

perhaps be asked, will be, how the Nitrous Particles of the Air are forced through thoſe Pores; which will be eaſily underſtood, by taking notice, that when the *Thorax* is violently contracted, the Air contained in the *Bronchia*, being violently preſſed together, in order to an Expulſion of it, a conſiderable Number of thoſe Particles of Nitre muſt needs be preſſed through thoſe Pores, that are wide enough to receive them, and that there are Pores wide enough, is viſible from what I have ſaid.

It appearing hence, how the Nitre of the Air is mixed with the Blood, I ſhall next conſider how it affects it, and what Effects it produces in reſpect of Heat.

To underſtand then the Effects that it hath upon all that Maſs of Humors, that circulates through the Veins and Arteries, to wit, Blood and ſerous *Lympha*, we are to conſider them both together, and apart; together, that it may appear how they influence each other; and a part, that we may know, for what end each is impregnated with thoſe Nitrous Particles; and becauſe when we are acquainted how it alters each ſingly, it will better appear how they influence each other; I ſhall firſt conſider them apart.

What Effects the Air hath upon the Maſs of Blood.

The Effects then, which we perceive the Nitre of the Air hath upon our Blood,

Blood, and the Alterations we are ſenſible it produces, are either in reſpect of it's Colour or Heat.

That the Air alters the Colour of the Blood, and makes it more florid, is very plain in extravaſated Blood, and is ſo commonly known, that I need not take any further Notice of it, but ſhall ſhew what other Effects it cauſes in the Blood, and how. *In reſpect of it's Colour.*

Having therefore explained the Heat of the Blood, in the foregoing Treatiſe, and it appearing that it is cauſed by a ſwift and violent Agitation of the Particles of the Spirits and Maſs of Blood; the way to underſtand, how Nitre affects

the Heat of the Blood is to conſider how it promotes, or hinders, the Motion of thoſe Parts of Matter, which cauſe Heat, which, as I conceive, and as Reaſon ſeems to evince, is performed after this Manner.

Nitre depreſſes the Heat of the Blood.

The Nitre of the Air conſiſting of Particles, not at all inclined to Motion; but on the contrary, diſpoſing thoſe Bodies they are mixed with to reſt, except by accident, when they are too powerfully reſiſted and oppoſed; Theſe, I ſay, being mixed with the Maſs of Blood, inviſcate and fetter up the moſt ſubtile Spirituous Parts, and hinder them from Motion; by which

which means, the more groſs ones are moved more ſlow, and the Heat of the Blood conſequently abated; but when the Maſs of Blood is ſo Elaſtick, and the Parts of it move ſo ſtrong, that the Nitre cannot depreſs them ſufficiently, and check them, the Heat of the Blood is increaſed; the Motion of thoſe Parts being inverted.

That the Nitre of the Air inclines thoſe Bodies to reſt, with which it is mixed, and conſequently the Blood, is not evident only by expoſing hot Water, to a cold freezing Air, but even Blood; and nothing is leſs dubious than that exceſſive Cold extinguiſhes a moderate Heat.

But that Nitre, when it is not

not powerful enough to check and extinguiſh the Heat of the Blood, does increaſe it, I have before explained, and the manner how it does it; and alſo, that it hath never thoſe Accidental Effects upon Liquids, except by hindring the fierce volatile Parts which ought to be diſſipated, from flying away through the Pores of the Skin, which being increaſed thereby to too great a Quantity, exagitate the Maſs of Blood too much,

From hence it breifly, yet plainly, appears, that the Nitre of the Air alters the Colour of the Blood; and alſo ſerves to temper the Heat of it.

I ſhall now conſider, what Effects it hath upon the ſerous *Lympha*; and if we may but compare it to Milk which differs only from Chyle, by being leſs impregnated with Oyl, it will be manifeſt, that it precipitates the Watry Parts of the *Serum*; which joyning with the fixed Salts of the Blood, diſpoſe them to be ſeparated, and carryed off by the Urinary Paſſages.

What effects Nitre hath upon the Serum *of the Blood.*

This is ſo ſtrongly proved, both by *Non-Naturals* and Medicine, that to deny it would be to contradict Reaſon, and plead Ignorance of thoſe Things it is almoſt impoſſible for us not to take notice of; for if we

ſit

ſit by a Fire in a cloſe warm Room, and drink a good Quantity of Beer, which is not very ſtrong; it preſently, if we go into the cold Air runs off by Urin, beſides nothing in Medicine, is a more known and common Diuretick, than *Sal. Prunel.* which is purified Nitre concentered and condenſed; and it is no leſs obſervable in an Experimental Obſervation of the Famous Dr. *Lower's* who in his Book *de Corde*, takes notice, that as much *Serum* is precipitated in a ſhort time after we riſe from Bed, as in the whole night, when we are leſs affected with the ambient Air.

How Beneficial Nitre is in Precipitating the *Serum* of the Blood, and what Advantages the Animal

Animal Oeconomy receives thereby, I ſhall not now enquire, yet how inconſiderable a Part of it's Office ſoever it may ſeem, yet if it be duly weighed, it will appear very uſeful.

From what I have ſaid concerning the Alterations made on the Blood and it's *Serum*; I ſhould now proceed to conſider, how they influence each other; but ſince as much as is ſufficient for our preſent Purpoſe, may be gathered from what hath gone before, it being plain that the cool *Serum* will help to temper the Heat of the Blood, and *vice verſa*; I ſhall wave a further Notice of it here, and ſhould rather ſhew; That,

The Lungs perform many more

more and conſiderable Offices in reſpect of each Part; But to explain them would not only be to treat of the Lungs, but the whole Body, and the Uſe of all the Parts; which being not my preſent Deſign, I ſhall omit giving an imperfect Account of them, becauſe they are ſo interwoven mutually with one another, that they cannot truly be underſtood, without an Account of the whole.

FINIS.

MVSEVM BRITAN NICVM